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WORLD PETROLEUM

Italian Attitude Toward Proposed United States Embargo of Oil Shipments • Appraising the Future of the Oil Industry • Construction of Bahrein Refinery Begins • Europe Looking to the East for Oil • British Drilling Permits Granted • Action by Congress Anticipated

JANUARY • 1936

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1936

WORLD PETROLEUM

VOLUME VII — **Editor, E. W. Mayo** — NUMBER 1

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Published Monthly by

RUSSELL PALMER

56 West 45th Street, New York, U. S. A.

Cable Address, Ruspam, New York and London

Advertising Manager, S. J. Gallay

Executive-Editor, T. Orchard Lisle

London: 3 Savoy Place, Victoria Embankment, W. C. 2

▼

OFFICES: Bendix Bldg., Los Angeles, Calif.
58 Sutter St., San Francisco, Calif.
Gulf Bldg., Houston, Texas.

Subscriptions

ANNUAL subscription to WORLD PETROLEUM is offered at the flat rate of five dollars (U. S.) postpaid to any country in the International Postal Union.

For the convenience of subscribers the publisher will accept payment in any of the following currencies at the fixed rate shown below:

Argentina	15 paper dollars
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Roumania	492.60 lei
Russia	1 chervonet
Venezuela	19.05 Bolivar

Remittances or drafts should be drawn to the order of the Publisher, WORLD PETROLEUM, payable in New York and London.

Subscriber's name and address should be in Roman capitals on the subscription order.

Official position of subscriber is requested.

Advance notice, if possible, of a change of subscriber's address should be given.

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The price of a single copy is 55 cents in Canada, 2 shillings in other countries of the British Commonwealth and the equivalent of 50 cents (U. S.) elsewhere.

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PETROLEUM

Oil Issue in Japan

IT IS DIFFICULT to understand the reasons that actuate the Japanese government in virtually repudiating the five-point agreement reached last summer with representatives of the international oil companies operating in that country. While it certainly would be something of a hardship to the companies should they be compelled to withdraw from this admittedly important market, it would seem to an impartial observer that Japan has even more at stake in maintaining dependable supplies of petroleum products under all conditions. While her own sources of crude, notwithstanding a vigorous campaign of exploration and development, show no considerable gain in output the demand for motor fuel and other products, both for commercial needs and for governmental requirements, is rapidly increasing.

Any real basis for a conflict of views between the national authorities and the oil companies is difficult to discover. Properly viewed their interests would appear to be complemental. The companies have a very large investment in the country, built up over the course of many years. They are anxious, naturally, to conserve this investment and if possible to make it productive of a reasonable return. Japan, on her part, needs the oil that the companies can supply and, so far as can be judged at present, will continue to need it for many years to come.

With the desire of the Japanese to increase the quantity of oil carried in storage as a partial means of meeting any emergency that may arise there can be of course no quarrel. But since this is a measure of national defence and the extra supplies are not needed for ordinary trade requirements it is reasonable that the companies should receive a fair return for the capital thus tied up. To ask them to maintain these excess stocks at their own expense, with the possibility that they may be taken over at any time at whatever valuation the taker may put upon them, and with the further possibility that this performance may be repeated over and over again, is to ask the impossible.

It may be of course that the Japanese authorities feel that the present high rate of production in California assures them of adequate supplies from that quarter. Competent geological authorities are agreed, however, that this high rate of production cannot be continued for very long without seriously depleting California's reserves. This situation was explicitly set forth in WORLD PETROLEUM in November, 1934. Oil men familiar with conditions in that area anticipate a rapid slackening of production within the next two years. Moreover, if Japanese policy is laid down with the sagacious estimate of long range possibilities usually attributed to it, account must be taken of a situation in which supplies from the United States might be shut off.

From an outside viewpoint it would seem that there should be no great difficulty in arriving at an understanding which would assure the accomplishment of Japan's desires in the matter of expanding oil reserves in storage, while at the same time extending to the international companies serving the Japanese market fair treatment in their operations and a fair recompense for the extra burdens they are asked to assume.

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Changing Panorama

AS A RESULT of the feverish race for the development of oil resources that has gone on all over the world during the past fifteen years there has been gross overproduction and reckless waste of invaluable resources. During the industrial depression of 1930 and the years immediately following, this condition made itself more evident than it had been previously. In those years millions of barrels of oil were brought to the surface that might better have remained underground; millions of dollars were sacrificed in selling petroleum products below their actual cost. For a long time we had, in the parlance of the street, a buyer's market in petroleum. Nations that wanted oil could obtain it from many directions and almost on their own terms.

This picture is changing, swiftly and strikingly changing. It is perhaps premature to say that the problem of overproduction is ended but the rapid rise in consumption that has taken place during the current year has done much to simplify it and if continued will presently abolish it altogether. Nations blessed with petroleum resources are tending more and more to conserve supplies and direct them to their own uses.

One consequence of this change is not difficult to foresee. In the future oil companies which operate internationally will be able to pick their markets. It is reasonable to assume that they will favor those in which they find fair treatment and equitable operating conditions. Governments which have indulged in unreasonable restrictions and extortionate taxation, amounting in some instances to virtual confiscation, may in time rue the lack of essential supplies which they themselves have been instrumental in driving away.

Italy's View of Oil Sanctions

Proposed Embargo Will Have No Effect on Military Program But Is Certain to Inflict Privation on Civil Population—Special Position of the United States.

TODAY the question of peace or war in Europe hangs largely upon the application of sanctions to shipments of oil to Italy. Such is the opinion held in the chancelleries of the leading powers who find themselves gripped by a situation for which they are responsible but which they may no longer be able to control. Through the turn of events the nation in whose hands the critical decision now rests is the United States.

The one government which has refrained from defining its position in this matter except through the medium of diplomatic protests is that of Italy. The following article is an attempt to present its view without prejudice, with no pretense to official status but with every claim to being an authoritative statement of the Italian viewpoint.

ROME, DECEMBER 10.

TO BEGIN WITH Italy is fully informed of the moves and countermoves that have been made at Geneva. She knows that whereas the proposal to extend sanctions to oil was put forward originally as one to be adopted only if joint action by the United States were forthcoming the situation has now changed. Some of the original adherents of the plan who have become less than lukewarm regarding it are being urged to continue their support on the ground that it must be carried through in order to keep faith with the government at Washington which is represented as being committed to a partial or complete embargo as the League may decide. Italy realizes fully that without the support of the United States sanctions will not be applied against her, at least not in a form that need cause Rome to worry.

Many of the nations that have agreed to the proposal for oil sanctions have hastened to assure the Italian government that they have done so reluctantly because of their obligations to the League and that they hope that any measures adopted will not be applied with severity. Italy appreciates the position of these countries. She understands equally well that the United States has no such obligations and supporting action by that country can be regarded only as a gratuitous affront. If sanctions are adopted through the action of the United States a degree of resentment will be felt that will hardly apply to any other country. Italy does not believe, however, that such a course will be adopted by a nation with which she has always had the most friendly relationship and to which she is bound by a thousand ties of common interest.

Non-Sanctionist Nations

A FACT which the Italian authorities feel may not be fully appreciated in the United States is the number of League members who have declined to apply sanctions against Italy. In all of Central and South America the only nation which is definitely committed to sanctions is Argentina while many of the others have declined to accept such a commitment. This is in addition to her near neighbours in Europe such as Austria, Hungary and Albania who have taken the same position.

Aside from the special considerations which apply to the position of the United States the attitude of Italy toward the attempt to deprive her of access to non-military supplies may be defined as follows:

Reversal of Progress

THE WHOLE TREND of international effort in modern times up to the present has been toward confining struggles between nations to the conflict of armed forces and to spare the civil population from the injuries and sufferings of war. Agreements to avoid the bombardment of unfortified towns and to spare the lives of non-combatants are instances of this trend. Now it is proposed suddenly to reverse this tendency and to enforce against Italy an unprecedented means of coercion that must inevitably bear most heavily upon the civilian population. For while the application of sanctions—and this applies particularly to oil—is defended on the ground that it will paralyze Italy's military operations it can have no such effect since the supplies necessary for these operations are already on hand or will be found, but it will disorganize the commercial life of the country and inflict unnecessary suffering upon the civil population.

More than most countries Italy depends upon motor transport for communication between her many small and otherwise isolated communities and has built up a vast network of fine motor highways to bring the different parts of the country into closer touch. It is the people in the small villages and country places who will suffer for food and other necessaries if the petroleum supply is cut off, except to such extent as substitute fuels can be found. Work in this direction is proceeding actively and motor vehicles now are being required to convert their engines to the use of wood gas if they are to continue in operation.

May Force Oil Monopoly

OIL SANCTIONS will force Italy to the establishment of a state monopoly. Sanctions in general will compel Italy, and by example other countries, to become more self dependent. It will rear still higher the trade barriers which some of the prominent advocates of sanctions affect to deplore and will postpone still further the restoration of world trade and prosperity.

In certain quarters a "standstill" agreement as to oil shipments to Italy is advocated in preference to a complete embargo. Behind this suggestion undoubtedly lies the desire to prevent a permanent diversion of Italian trade to countries not accepting sanctions so that when the period for which they apply is ended the countries which previously enjoyed the larger share of commerce with Italy will have lost nothing. There is a fear in certain countries, for example, that Italy's oil requirements in future may be drawn from the American hemisphere, North or South.

No Military Effect

OIL SANCTIONS cannot have any effect upon the military operations on which Italy is now embarked. Assurances have been given the Italian authorities of suffi-

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At the bottom of a growing feeling of international tension: Oil in Massawa, Eritrea, intended for the Italian Campaign in Ethiopia.

cient petroleum and petroleum products to meet their requirements in this direction. Sanctions can and will inflict privation and suffering upon the civil population, will create new and bitter animosities and will further disorganize world trade and the mutual confidence upon which friendly international relations must be based.

Gravest Danger in Sanctions

FROM the Italian viewpoint the gravest danger in oil sanctions is this: When it becomes evident, as it will, that mere paper orders are not effective in stopping the flow of oil to Italy the next step to be advocated undoubtedly will be a blockade, the search and seizure of ships and similar measures to prevent what will be regarded from the League point of view as smuggling. The possibility that such action will set off the spark starting an international conflagration is obvious. Against such measures of blockade Italy might feel compelled to institute search and seizure on her own account. Such steps lead inevitably in the direction of war.

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World Petroleum Directory

WORLD PETROLEUM DIRECTORY—1936 EDITION. Since the previous edition of WORLD PETROLEUM DIRECTORY was issued a great many changes have taken place in the petroleum industry. These changes affect the personnel of many oil companies, their physical properties, their marketing operations and trade relationships. They are all incorporated in the present edition.

Many other changes and additions have been made. Since the usefulness of a reference volume depends largely upon the ease with which users can locate the special information for which they are searching particular attention has been devoted to making the contents of the Directory readily accessible. The General Index covers every probable reference and is printed on paper of a distinctive color. Listings have been entered in alphabetical order by countries. Running lines at the top of each page indicate the page contents. Information received too late to classify has been given a separate entry beginning on page 1132.

Because of the large number of oil companies in the United States these have been grouped in a separate section at the beginning of the book. Producing, refining, pipeline and marketing companies in other countries follow in alphabetical order. Many additions have been made to the list of marketers and jobbers in the United States which is believed to be the most complete and accurate ever published.

Other lists include compounders and grease manufacturers, asphalt manufacturers, producers of liquefied petroleum gas and oil associations. Its text occupies 482 pages more than the last issue and apparently no effort has been spared to include in its pages in compact form all the information that properly belongs in a reference volume dealing with the world's petroleum industry. A number of new sections have been added embracing transportation, tanker fleets, bunker stations, brand names, oil futures trading, personnel, etc.

Because the information contained in this volume is essential to day by day operations of many thousands of members of the world oil industry, the revised and enlarged 1936 edition is assured of an even more enthusiastic reception than the earlier editions.

Appraising the Oil Industry's Future

Despite Greater Uncertainty Confronting General Industry than Ever Before, Careful Analysis of Important Factors Affecting Petroleum Justifies an Optimistic Outlook.

By Lester C. Uren
Professor of Petroleum Engineering
University of California

THE PROBLEM of estimating the prospective future demand for crude petroleum can best be approached by reviewing past production statistics and current trends in the petroleum consuming industries. We should be interested not alone in the statistics of past and current demand, but also in the allocation of the crude supply among the more important refined products. Of the several marketable products, four will receive particular attention, these being gasoline, fuel oil, kerosene and lubricants. An effort will be made to present the essential data concerning each of these products on the basis of which, one might form an intelligent opinion of the future demand.

In studying the trend of consumption in the various fields of application of petroleum products, those representing the greater percentage of the crude are particularly significant in estimating future crude requirements. The percentages of the crude supply represented by the several more important refined products, have been slowly changing during recent years, as indicated by the graphs of Fig. 1. Gasoline has represented a rapidly increasing percentage of the crude during most of this period, while other important components have been slowly diminishing in percentage.

Gasoline and fuel oil represent the more important components of crude petroleum from the volumetric stand-point and we must therefore give particular attention to them. Any important increases or decreases in the consumption of these two products in future years, will necessarily have a greater influence on the demand for crude petroleum than any changes that might develop in the demand for kerosene or lubricants, each representing but a few percent of the crude production. The remaining percentage of the crude, amounting to only about 1.5 percent, is utilized in the manufacture of asphalt, paraffin wax, petroleum coke and other products of minor importance from the volumetric stand-point.

CAREFUL analysis of recent trends and of the factors operating to maintain or change these trends gives an indication of the progress or retrogression of the petroleum industry and makes possible an estimate of probable future developments. The beginning of the new year is a particularly appropriate time for such stock taking. WORLD PETROLEUM deems itself fortunate to have obtained from the well known petroleum authority, Professor Lester Uren, the accompanying article in which he attempts to determine from existing trends within the petroleum industry and the general industrial outlook the probable answers to such important questions as: May we expect an increasing demand for petroleum products in the years just ahead? Which products will show an increasing and which a declining tendency? Will domestic reserves be adequate to supply the prospective demand or will the United States have to seek additional imports from abroad? Will the price structure be higher or lower?

Trend of Gasoline Consumption

GASOLINE is today the most important petroleum product from the stand-point of percentage of the volume of the crude production and is the most important single source of income and profit to the industry. Fig. 2 presents in graphic form, the statistics of the gasoline industry during the last seventeen years. It will be noted that during most of this period, the domestic production and consumption have been rapidly increasing. Only during the single year 1932 was there a lesser consumption of gasoline than during the preceding year: a truly remarkable record of continued expansion in utilization scarcely realized by any other widely used industrial commodity. Though the United States is supposed to be only slowly emerging from the most severe depression in all its history, production and consumption of gasoline in this country was greater in 1935 than in any previous year.

Looking into the future, a further increase in the domestic demand for gasoline seems inevitable, though the rate of increase in consumption will possibly soon diminish. The automotive industries are of course, the important consumers of gasoline, and further development of this field of application is likely to continue for many years. During the period under review, the number of automotive vehicles in use in the United States has been continually increasing, except during the depression years 1930–33. A very satisfactory increase in the number of automotive vehicles in use has been realized during the last two years and is in prospect for next year, promising an increased demand for motor fuel during the coming years.

Though recent improvements in automotive engine design have resulted in greater fuel economy, because of the increasing mileage that the average motor car is driven each year, the annual gasoline consumption per car has been increasing rather than diminishing. Important improvements and extensions in our highway system and all-weather use of the automobile, as well as the increasing use of motor busses for passenger transport, of motor trucks in the movement of freight, of small gasoline-powered boats and of tractors for agricultural and industrial purposes, are all factors that promise continued increase in the demand for motor fuels.

Further development of commercial aviation promises to create an important additional demand for gasoline, sufficient perhaps to offset the diminishing rate of increase in the number of automobiles.

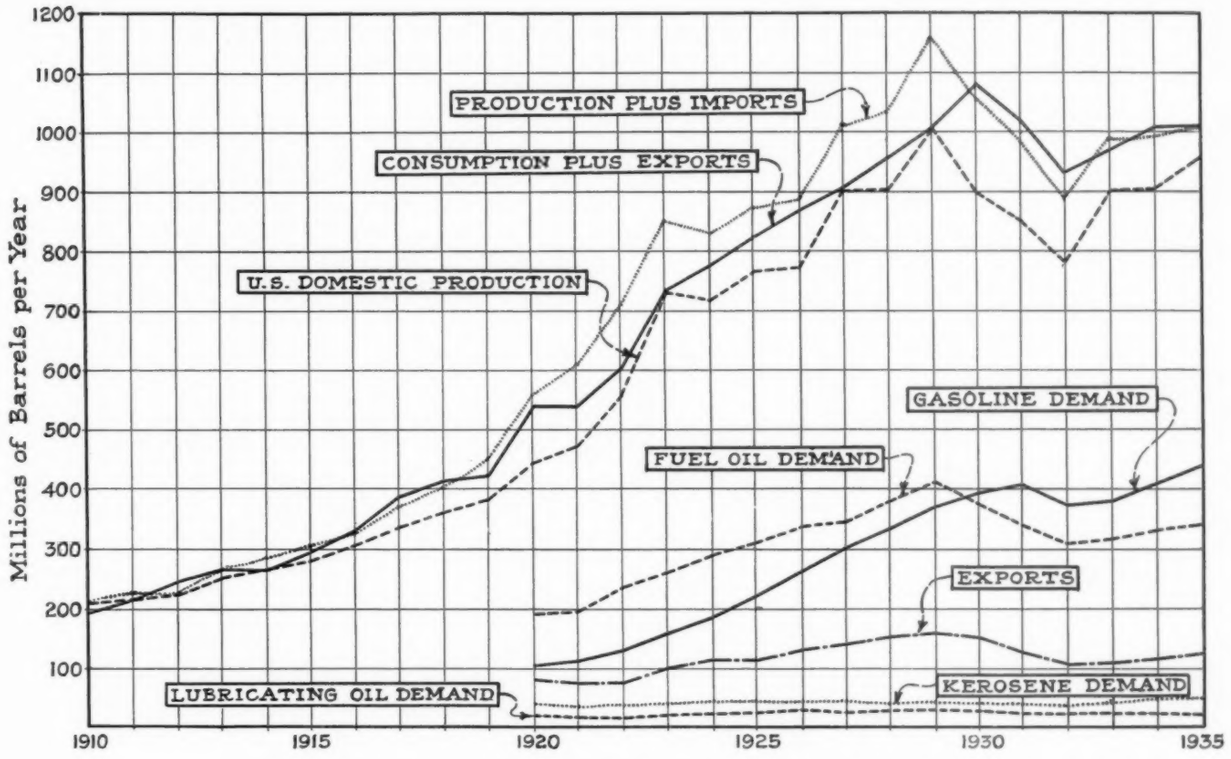

Fig. 4—Graphs showing crude petroleum supply and demand during the period 1910–1935 and U. S. consumption and exports of the principal petroleum products during the period 1920–1935. (Figures for 1935 are estimated on basis of records for first nine months)

While aviation is responsible for but a very small part of the present demand for gasoline, it is a demand that is rapidly increasing. This field of application is still in its infancy, possibly in about the same stage of development as was the automobile twenty or twenty-five years ago. If aviation occasions anything like the development that the automobile created in the petroleum industry in the years following 1915, the next twenty years should witness the establishment of an important new outlet for gasoline that may ultimately prove to be as great or perhaps greater, than that now afforded by the automobile. The aeroplane is a large consumer of gasoline, the average plane traveling a much greater mileage than the average passenger automobile and probably attaining not more than a third of the miles-per-gallon achieved by the automobile. Furthermore, a high grade of fuel is required.

An adverse factor that promises to restrict to some extent the prospective growth in future demand for gasoline, is found in the increasing use of the Diesel type of engine in the automotive industries. Recent improvement in design of Diesel engines giving greater flexibility and the proven economy of this type of engine are leading to its rather widespread use in trucks and tractors and even to some extent in busses and pleasure cars. It has also been successfully used in an experimental way for aviation purposes. The principal incentive for replacement of the gasoline type of engine by the Diesel type is found in its greater economy and lower fuel costs. Continued expansion in use of automotive Diesel engines may eventually cut seriously into the market for gasoline but its success in this direction would probably bring a substantial increase in price of Diesel oil, thus partially nullifying the advantage that the Diesel engine now enjoys.

Trend of Fuel Oil Consumption

FUEL oil, though not productive of as much revenue to the petroleum industry as gasoline, represents a volumetric percentage of the crude approaching that of gasoline. In earlier years, fuel oil constituted a residue product, comprising that part of the crude which could not be made to yield more valuable products by the refining methods then available. Before the advent of cracking and even to some extent in recent years, fuel oils have been produced in excess of market requirements so that great quantities have accumulated in storage and the price has been depreciated far below its intrinsic value. Modern cracking processes however, have provided a means of converting a large percentage of this low-priced product into gasoline and other light distillates. As a raw material from which gasoline may be produced, fuel oil now becomes a competitor of crude petroleum and assumes new economic significance. The logical result of this development would be to depreciate the value of gasoline and increase that of fuel oil.

For statistical purposes, gas oil and furnace oils are included with fuel oil and in the present analysis we shall adhere to this classification. Fig. 3 displays the more important statistics of fuel oils as a group. The total fuel oil production, including domestic consumption, exports and surplus going into storage, as shown by the graphs of Fig. 3, increased steadily up to 1929, but has suffered a considerable shrinkage from the 1929 production peak during the depression years. During the

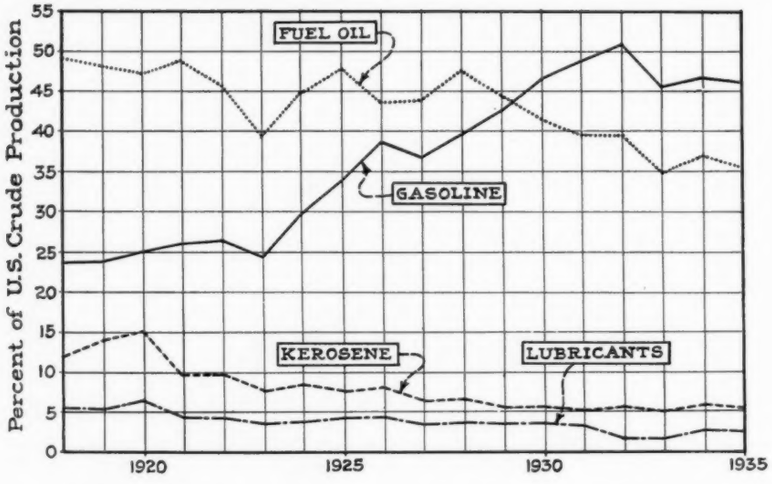

Fig. 1—Graphs showing variation in percentage of crude supply represented by principal petroleum products, 1918–1935. (Figures for 1935 estimated on basis of statistics for first nine months)

last three years, the production and domestic consumption of fuel oil have shown a slightly increasing tendency, but the rate of increase is still below the pre-depression peak. In recent years, exports of fuel oil have been but little more than half what they were in 1929, but have also shown a slightly increasing tendency during the last three years. Stocks of fuel oil in storage, which reached an all-time peak in 1929, have since shown a continual decline.

Fuel oil finds wide-spread use in many large and stable industries and there are in addition, many hundreds of thousands of domestic consumers. Its present commercial position is therefore well established and a well sustained demand for the product seems probable if an adequate supply at a reasonable price can be assured. The transportation industries, including steam-ships and the railroads, are the most important consumers of fuel oil, utilizing half of the available supply. Oil companies, manufacturing industries, gas and electric power plants, smelters, mines, foundries and steel mills rank in the order given among the consuming industries. Commercial and domestic heating also represents a field of utilization that is a factor of increasing importance.

Considering briefly the recent trends in these different fields of utilization of fuel oil, we may better gauge the prospective demand. In the transportation industries which, as stated above, consume nearly half of our fuel oil supply, use of the product has been continually increasing, particularly in marine transport, which alone represents nearly 25 percent of our total fuel oil market. The quantity of fuel oil consumed in supplying power for the railroads has also been expanding for many years and recent development of the stream-lined Diesel-engine-powered locomotive promises in future years to revolutionize rail transportation, still further increasing the demand for fuel grades of oil. In the manufacturing industries, the trend toward fuel oil has been less rapid and during the depression years, has materially declined. Use of fuel oil in heating buildings and homes on the other hand, has been increasing. About the only important field of application where ues of fuel oil appears to be diminishing, is in the public utilities, where hydro-electric power and natural gas have been making rapid inroads: a trend which promises to become even more pronounced in the years just ahead when government electric power projects now under construction come into service. Utility consumption however, represents less than 10 percent of the total fuel oil demand and should not be a matter of great concern to oil producers in view of the definite promise of profitable markets for fuel oil in other directions.

Considering these trends in the several consuming industries in the light of opportunity for future growth in fuel oil demand, it seems probable that an increasing demand for fuel oil may continue into the future. More than half of the world's merchant ships still burn coal. More than three-quarters of the power used on the railroads of this country is developed by burning coal. Except where hydro-electric power may find use on the railroads, both of these fields of industry will probably eventually turn to fuel oil in meeting their power needs, the fuel being either burned under steam boilers or in Diesel engines. The manufacturing industries develop approximately 60 percent of their power requirements by burning coal. Less than one-eighth of the homes in this country are yet heated with fuel oil. Recent development of natural gas resources may stop the trend toward fuel oil in these applications for a few years, but as our natural gas is depleted, our utilities must resort to the use of coal or fuel oil in increasing amounts in the manufacture of gas; and in certain parts of the country, as on the Pacific Coast, where coal is expensive and fuel oil plentiful, the latter must be chiefly depended upon. Our normal population and industrial growth will afford continued expansion of the fuel oil market even after the period of "saturation" in these different fields of utilization is reached.

It is obvious that future development of the fuel oil industry is dependent upon favorable price, for otherwise it may not successfully maintain its present position in competition with coal. It is worthy of note however, that in the regions where fuel oil finds its most extensive use, the present price is materially below its intrinsic value in comparison with the cost of coal. Many believe that the fuel oil industry will be short-lived: that we cannot hope to produce petroleum in sufficient quantity to meet the growing demands of the fuel-oil consuming industries and that petroleum refiners and marketers should therefore refrain from seeking new outlets for fuel oil. Some insist that it represents an inferior use of petroleum and that oil now used for fuel purposes had better be conserved to meet the future gasoline demand. It is urged that coal can serve most of the industries that now make use of fuel oil. Such a view-point ignores the fundamental advantages and economies to the consumer that liquid fuel offers in comparison with solid fuel: advantages that have led to its wide-spread displacement of coal as an industrial and domestic fuel. The consumer is willing to pay for these advantages: probably a much higher price than he pays today. Fuel oil is almost as essential to many fuel oil consumers as is gasoline to the motorist and the two are likely to become competitors in future years for their share of the crude production. We shall always have a substantial fuel oil market, for it is now possible to produce fuel oil from coal or oil shale at prices well within the upper price limit that the consumer can afford to pay for the product.

Trend of Kerosene Consumption

KEROSENE, representing only about six percent of the crude production, is of

minor interest in comparison with gasoline and fuel oil, nor does it seem to promise development of any great importance during the next few years. Except for the early years of depression, the U. S. domestic consumption of kerosene has shown a gradually increasing tendency: a trend which has again been resumed during the last three years. The domestic consumption during 1934 was greater than that of any previous year and the 1935 consumption probably exceeded that of 1934. For many years, prior to 1929, about a third of the U. S. kerosene production was exported, but the export business in this product during recent years has been less than half that of the pre-depression era. A slowly increasing consumption of kerosene is visualized for the coming years, particularly if any part of our export trade can be revived.

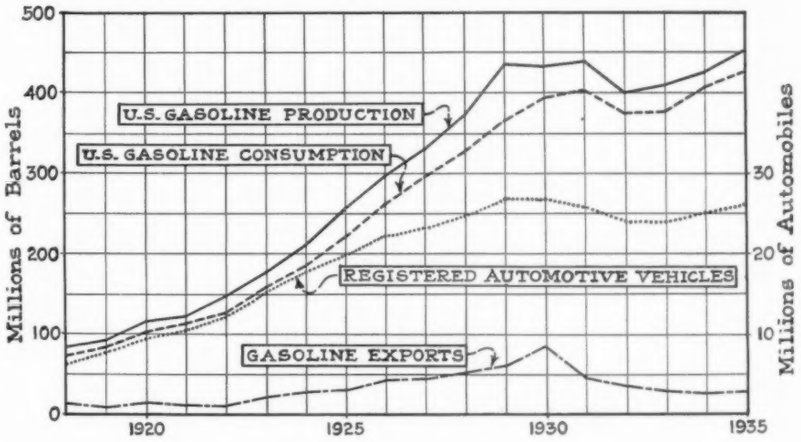

Fig. 2—Graphs showing U. S. gasoline production, consumption and exports and automotive vehicles in use, 1918–1935. (Figures for 1935 are estimated on basis of statistics for first nine months)

Trend of Lubricating Oil Consumption

LIKE kerosene, lubricating oils represent but a small percentage of the gross consumption of petroleum, and the potential demand for them does not promise to play more than a minor role in determining our future petroleum requirements: at least not during the next few years. Roughly, the same considerations that have been found to promise increased demand for gasoline in future years, apply also in the case of lubricating oils. The automotive industries are at present the most important consumers, though aviation will no doubt provide an important new outlet in the coming years. In a broad way, every industry making use of mechanical equipment of any type is a consumer of lubricating oil, and as the mechanization of industry continues, more and more lubricating oil will be needed. Prospects for a long continued steady growth in the demand for lubricants appear excellent.

Influence of the decline in industrial activity in the United States and in exports of lubricating oil, is clearly apparent in the production and consumption statistics of recent years. However, the domestic consumption has for the last four years been increasing and is again approaching the pre-depression level. As in the case of kerosene, during earlier years more than a third of the U. S. production of lubricating oil has been exported and the recent reduction in international trade has been an important factor in the reduced demand for American lubricants.

Trend of Export Demand

AS THE world's greatest producer of petroleum and refined products, and controlling as it does, something like three-fourths of the world's refining capacity, other countries have come to depend upon the petroleum industry of the United States for a considerable part of their oil supply. They will doubtless continue to be important consumers of American petroleum products in future years. During the next five or ten years at least, the American oil industry must continue to supply a substantial part of the world's oil needs. New sources of supply in other countries and new refinery capacity outside the United States of sufficient magnitude to influence the American export trade to an important degree are not likely to be developed in less time.

The various avenues of petroleum utilization are better developed in the United States than in any other country of the world. The annual per-capita consumption of about eight barrels is far greater than that of any other country. Oil-consuming industries are relatively underdeveloped in other parts of the world. For this reason, if exchange, political and other factors governing international trade permit, there will probably be a more rapid growth in future demand for oil products abroad than will exist in the United States.

Gross exports of petroleum and petroleum products have been substantially curtailed during the last five years of industrial depression. Dislocation of the channels of world commerce has resulted in shrinkage of exports of oil products to substantially two-thirds what they were during 1929. The export demand for refined products has suffered nearly a 50 percent loss, and were it not for a considerable increase in export of crude oil during recent years, the loss would have been much greater. The trend of U. S. exports during the near future is clouded in uncertainty, being largely concerned with prospects for stabilization of currencies, European war, international boycotts, war debt settlements and other factors having a profound influence on world commerce. Should conditions outside the United States prove favorable, the American export trade in oil products during the next few years may be expected to expand materially above present levels. It does not seem likely that any combination of events will reduce them much below present levels.

U. S. Oil Reserves

IN DISCUSSING the domestic reserve of crude petroleum available for future use of the people of the United States, it must be admitted at the outset that it is at present unknown and is furthermore, from the very nature of the problem, indeterminate. The petroleum reserves may be broadly classified into three groups: a) The visible domestic reserve in present-known fields, producible by present recovery methods; b) The visible domestic reserve in present-known fields producible by future improved recovery methods; and c) The invisible domestic reserve producible from fields yet to be discovered, or in at present unknown extensions or deeper zones in present producing fields. To these we might add two other classifications, though the first is not an inalienable reserve and the second is not properly speaking, a petroleum reserve. These are: d) That part of the world's supply of petroleum to be produced in future years outside the United States, the owners of which may be induced to market it in the United States; and e) Reserves of various natural substances and products from

which petroleum substitutes may be derived—such as oil shale, coal and miscellaneous vegetable products.

Only the first of these reserves can be measured with any degree of accuracy. The possible production obtainable from reserve b) is largely a matter of conjecture, for we can only guess at the probable efficiency of such improved methods as are now available or as may be made known in future years. The future supply to be realized from reserve c) is totally unknown and it is unfortunately, upon this undiscovered reserve more than any other, that we must in the main, depend during the next ten or twenty years. It seems probable that as time passes, we must depend to an increasing degree upon oil imported from other countries—reserve d). When this is no longer available or adequate for our needs at a reasonable price, we must exploit our last reserve—group e). Fortunately this reserve is of such magnitude that it would seem to be adequate for our needs for many centuries. This last reserve gives assurance that the United States will not be without a supply of oil products for our essential needs for many generations, though many changes in production technology and industrial application will have to be effected before these substitute products are available in quantities sufficient to replace any important part of our present petroleum supply.

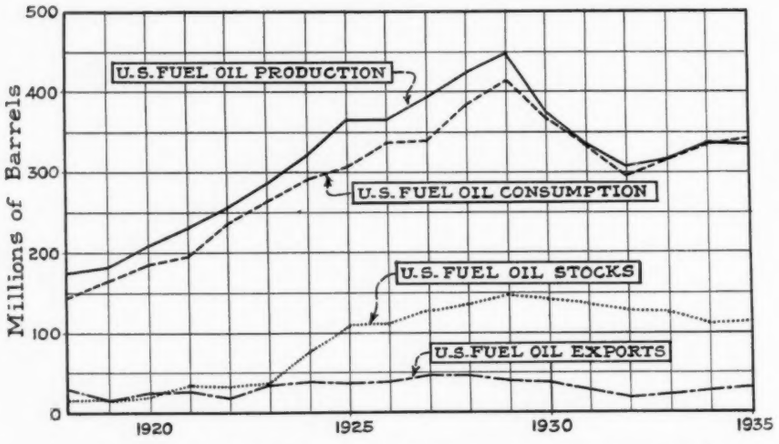

Fig. 3—Graphs showing U. S. production, consumption, exports and stocks of fuel oil, 1918–1935. (Figures for 1935 are estimates based on statistics for first nine months)

THE VISIBLE RESERVE IN PRESENT-KNOWN FIELDS PRODUCIBLE BY PRESENT ORDINARY RECOVERY METHODS. After oil fields reach a certain stage of development, it is usually possible by engineering methods, to make reasonably satisfactory estimates of their future production. Estimates of this character assume that ordinary methods of recovery, involving natural flow, gas-lifting or plunger pumping, will be continued throughout the productive life of the field. From time to time, based on such methods of estimation, surveys have been made of the total visible reserve in American fields discovered prior to the time at which the surveys were made. They are of value only as a means of judging to what extent the reserve is keeping pace with the quantities produced. The accompanying table gives the total visible reserve as estimated at eight different times since 1908 by as many different authoritative surveys. The writer has added the last two columns giving the current rate of domestic production during the years in which the surveys were made and the corresponding number of years' supply at the then current rate. It is of course, understood that in thus stating the years' supply, the writer does not assume that the apparent reserve could actually be exhausted in the number of years specified. Because of the decline characteristics of oil wells, the recovery of this reserve must necessarily be spread over many years, it being impossible at any time to maintain the current rate of production for more than a few years without discovery of additional reserves.

Many have ridiculed conclusions based on the results of these surveys, pointing out that the rate of production has continued to increase and that the reserve set up at certain times—as in 1915—would long since have been wiped out by the oil actually produced: and yet we still have substantial reserves. This simply means that new reserves have in the interim been discovered to supplement the previously known reserve. The figures given are to be regarded not as estimates of total reserves as these critics have assumed, but rather as estimates of visible developed reserves. An important fact to be noted about Table I is that the visible years' supply, measured in terms of the current rate of production has been rapidly diminishing during the last quarter of a century. Even the great activity of recent years in searching for and developing new fields, aided by the new science of geophysics and recently developed deep-drilling technique, has not greatly increased the visible years' supply. Many believe that we have reached a situation in which our visible reserve, measured in terms of current and prospective demand, is lower than it should be adequately to safeguard an oil industry of the present proportions. Knowledge of a substantial shut-in production sufficient to support for a time, a rate of production some two or three times our current needs, has given to many a false sense of security in connection with this matter of visible reserves. Without recurrent new discoveries, this surplus production would be quickly wiped out. A large part of our currently marketed production is flush production derived from recently discovered fields, and we must continue to find new fields else our production rate will quickly decline.

THE VISIBLE DOMESTIC RESERVE IN PRESENT-KNOWN FIELDS PRODUCIBLE BY FUTURE IMPROVED METHODS. Past and present methods of oil recovery have been and are notably inefficient. Estimates of percentage oil recovery by present-day commonly-used methods, utilizing only the expulsive forces provided by nature, range from 10 percent to 50 percent. All of the evidence indicates recoveries of the order of 10 percent to 20 percent of the original oil content of the reservoir rock in most cases, with recoveries as high as 50 percent seldom if ever attained. Since 1859, upwards of 17,000,000,000 bbl. of petroleum have been produced in the United States. If we assume that the average recovery has been say, 20 percent, there is still four times as much oil left in present-known fields as have already been produced, or 68,000,000,000 bbl. Adding to this, four times the oil still producible by present methods in fields now known, and we have a total volume, not producible by ordinary present-day methods, of some 116,000,000,000 bbl. In 1925, the Committee of Eleven of the American Petroleum Institute conservatively estimated this reserve at slightly more than twice the volume of oil previously produced, or 26,000,000,000 bbl.

Just how much of this oil is really producible, is problematical. The more efficient methods of recovery to which we at present look for aid in securing some of the oil not now producible by ordinary recovery methods, include repressuring, air or gas driving, water flooding and mining. Probably the most efficient of these is that of flooding through mine openings, a method which may under favorable circumstances, yield as much as 50 or 60 percent of the residual oil. Flooding, repressuring and gas-driving through surface wells are methods that are probably considerably less efficient. Not all of our partially developed fields however, are susceptible of exploitation by these methods and it seems improbable that we can hope economically to produce anything like 50 percent of the residual oil remaining in our partially depleted fields after present-day natural methods have ceased to be effective. In the light of practical experience with these methods up to the present time, 25 percent would be a more probable figure and even this could scarcely be considered as conservative. This would mean that perhaps 25,000,000,000 bbl. could ultimately be secured from this reserve. It will be understood, however, that still more efficient methods of recovery than those now visualized may in future, be devised, perhaps increasing the magnitude of this reserve. The supply available from this source will also be dependent upon the future price.

It will be inferred from the above discussion that while we are justified in thinking of this unrecovered oil in the older fields as a reserve, the ultimate supply that can be derived from this source is quite uncertain. It seems quite certain however, that this oil will be considerably more costly to produce than oil secured by natural methods and that its recovery will necessarily extend over a long period of time. In other words, the rate of recovery that may be developed from this reserve in the near future, is probably small, so that it would not bulk large in our present rate of production of nearly 1,000,000,000 bbl. per year.

THE UNDISCOVERED DOMESTIC RESERVE. It has been suggested above that the rapidly increasing production of petroleum in the United States has been attained by recurrent discoveries of new fields. Without new flush production, the current output would quickly decline. Statistics show that the current production at any time is in large part, flush production from recently discovered fields. Obviously, it is vitally important that we continue to discover new fields at timely intervals to off-set the rapid decline of recently discovered fields now in flush production. Ability further to increase the rate of production, or even to maintain the present rate for more than a few years, is dependent upon the ability of the industry to find new reserves. How long can we continue to find new pools in this country at a rate sufficient to maintain the present rate of production? Doubtless, many additional pools will be found, but what is the order of magnitude of this undiscovered reserve? Obviously, no one can know: even when the last pool is entered by the drill, we will not know. There are however, certain indicators and a certain line of reasoning that may enable us to estimate whether the rate of discovery is likely to increase, remain constant or diminish in the years to come.

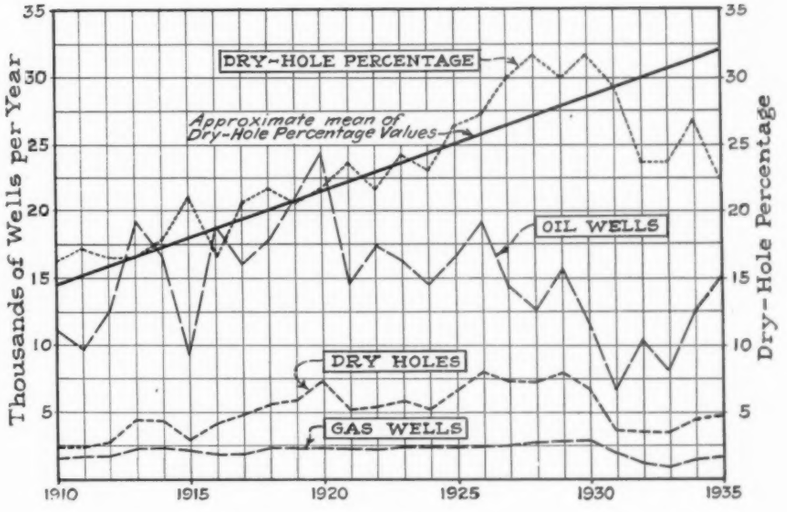

Fig. 5—Graphs showing classification of wells drilled in the United States, 1910–1935, indicating increasing "dry-hole" percentage. (Figures for 1935 estimated on basis of records for first nine months)

In dealing with a hidden, wasting resource, it is inevitable that at some time we must reach a maximum rate of production; that some day the remaining undiscovered pools in this country will become so few in number and so difficult and costly to find, that we will not be able to maintain the rate of discovery necessary to attain the previous year's rate of production. Whether this period is to be reached in the near future or many years hence, is the crux of the whole situation: the one factor more than any other that will determine the future trend of the American oil industry.

There are many who have expressed the belief that the peak of production in this country is imminent, or has perhaps already passed (1929). Others place the production peak many years—even centuries—into the future. Most expressions of opinion on this all important matter have been colored by the exigencies of the occasion and too often, unfortunately, by the personal interests or group interests represented by the speaker. A short period of increasing prices and diminishing visible reserves will give encouragement to many pessimists who see nothing but a severe shortage of petroleum and disaster ahead. A year or two of over production and there will be as many expressions of confidence in a long-continued era of ample supply. Let over production become critical and threaten a severe price depression and the reserve becomes boundless! Which view may we reasonably adopt; or is either correct? May not the answer more reasonably lie somewhere between these two extremes of viewpoint? Before attempting to reach a conclusion on this point, we may profitably spend a little time in reviewing such evidence as is available.

THE INCREASING DRY-HOLE PERCENTAGE. The difficulties and uncertainties in finding new production are indicated in a way by the percentage of wells drilled each year that fail to develop production. Most of these dry holes are wild-cat wells drilled in efforts to find new pools or to develop extensions of known pools. For many years, statistics showing the total number of wells drilled for oil and gas and those productive and non-productive, have been assembled by government agencies. (See Fig. 5) Inspection of these figures shows that the dry-hole percentage has gradually increased from a low value of 16 percent in 1910 to 31.7 percent in 1930. During the last

five years, fewer wild-cat wells have been drilled and such drilling as has been done has been largely within proven areas—such as the East Texas Field—where production has been more certain. Hence the dry-hole percentage has diminished somewhat below the 1930 peak. The general upward trend of the dry-hole percentage is no doubt, indicative of greater difficulty and uncertainty in finding new production. When the cost of a third of the wells drilled must be carried as an over-head charge on the development operations of the industry; when this charge has doubled within a period of 20 years, and when it promises to increase in future, probably at an accelerating rate, we cannot escape the conclusion that this is a trend that will ultimately curtail development activity and hence diminish the rate of discovery of new pools. It may be argued that the deeper wells now being drilled are more prolific so that we do not need so large a percentage of successful ventures, but deeper wells also cost more, and production obtained from them is more costly and therefore, less profitable. The average dry hole of 1934 cost more than four times as much as the average dry hole of 1910.

Comparison of Estimates of the Visible Petroleum Reserve in the United States

Date of Estimate	Authority	Apparent Reserve, Bbl. 000,000,000 omitted	Current Rate of Production, Millions of bbl. per year	Years' Supply at current rate of production
1908	David T. Day†	8 014 (min.) 22 514 (max.)	178.5	45
1914	Ralph Arnold	5 760	265.7	22
1915	U. S. Geologic Survey	7 704	281.1	27
1918	David White	6 740	335.9	19
1921	U. S. Geol. Survey and Am. Assoc. Pet. Geol.	9 150	472.2	19
1925	Committee of Eleven, Am. Petrol. Institute	5 300	763.7	7
1932	Federal Oil Conservation Board	10 000	953.3	11
1935	American Petroleum Institute	12 177	950.0*	13

† Day's estimate included maximum and minimum values.

* Domestic production for 1935 estimated on basis of first nine months' production.

The Rate of Discovery of New Pools. If in 1946, ten years hence, we are to have a visible reserve producible by ordinary methods, equivalent to that of today, we must find nearly 10,000,000,000 bbl. of new production during the same period. This is about two-thirds of the total volume of oil produced in this country during the entire 76 years of the American oil industry. Discovery of 10,000,000,000 bbl. of new production in ten years means the equivalent of one East Texas field every other year. Can we hope to maintain such a discovery rate?

The present rate of production has been attained and maintained during the last ten years only by the expenditure of very large sums of money in searching for new reserves and by the adaptation of new methods of exploration and production and improved deep-drilling equipment. More footage has been drilled during this period than during any previous ten-year period. More capital has been expended in exploration and development work than during any previous ten-year period. Geologists, aided by the new science of geophysics have conducted detailed surveys in most of the more promising prospective areas. New pools which would otherwise have remained unknown for many years, have been discovered and developed as a result of recent advances in oil-finding technique. The science of deep drilling has made unprecedented advances within this ten-year period and sands far deeper than those previously within reach of the drill have been exploited. The gas-lift and other improved systems of oil production and well control have made it possible to extract oil from the new pools more rapidly than was previously possible.

While advances in engineering and technology promise further development in this direction, this very acceleration in the rate of discovery and production operates to hasten the day of exhaustion. There are but a certain number of pools yet to be discovered; each advance in oil-finding technique that makes known additional sources of supply, leaves a fewer number for the future and unfortunately, those that are left will be the more difficult to find and develop. The more obvious places to drill test wells have already been drilled. Unless some new and at present unexpected discovery in oil-finding technique is made, it would seem that our recent rate of discovery of new pools must soon decline. Many of the last pools to be discovered will be found only by drilling in locations selected on the basis of very slender surface evidence. This period will doubtless be marked by excessive exploration and development costs and a high dry-hole percentage.

The evidence seems to indicate a condition of approaching maturity in the American petroleum industry. Nevertheless, the peak of production may still be many years hence and production may be maintained at or near the peak for several years. All available data suggest a slow decline from the production peak. If we were dependent alone upon production from visible reserves, the early decline would be precipitous, but the probabilities are that flush production from occasional new fields will maintain the annual rate of production at somewhere near its highest level for some years before serious reduction in the supply would result.

Supply of Oil Products Available from Sources Other Than Liquid Petroleum. The quantity of motor fuel reaching the American market is augmented to a limited extent by benzol produced in the distillation of coal and by natural gasoline extracted from natural gas. New methods of polymerizing refinery and natural gases are also available for the production of motor fuels. The 1934 production of natural gasoline represented 8.6 percent of the gross motor fuel supply of that year, while benzol contributed only four-tenths of one percent. It seems improbable that these sources of motor fuel supply will greatly increase their quotas during the years just ahead. Polymerizing plants now under construction will contribute a small but increasing amount of motor fuel; yet it is considered unlikely that more than an insignificant percentage of the total supply can emanate from this source within the next few years.

Eventually, vast quantities of petroleum substitutes will be produced by distillation of oil shales or by low-temperature carbonization and hydrogenation of coal. These processes are now well understood and can readily be applied in the event that our supply of petroleum should prove inadequate to satisfy the demand for oil products. Alcohol derived from vegetable sources may also be used as a motor fuel in substitution for gasoline, and satisfactory lubricants may also be prepared from certain vegetable and animal oils. The raw materials from which these substitute products may be prepared are present in great abundance in the United States, doubtless sufficient for many years supply. The cost of producing motor fuel from these sources however, would necessarily be considerably greater than the

average production cost of present-day motor fuel; yet probably not so high as seriously to restrict use of the product in its present fields of application.

Future Supply of Petroleum Available from Outside the United States. Today, we restrict importation of petroleum and petroleum products into the United States as a measure of protection to the domestic industry. Yet, in case of need, except possibly in time of war, we might expect to import large quantities to supplement our domestic supply. The oil resources of South America and Mexico are undoubtedly extensive. These fields are in large part, under the commercial control of American oil companies and the United States would in time of domestic shortage, offer a natural market for much of the crude and refined products derived from them. It must be realized however, that European and other civilized countries of the world are rapidly awakening to the possibilities of oil. Their per-capita consumption of petroleum products is much less than our own and the demand for increased supplies may therefore be expected to become more insistent abroad than in the United States. Today we have ample productive capacity to take care of domestic requirements, but eventually we shall have to compete with other nations for such world supplies as we will need to supplement our own reserves. However, importation of oil could only continue at a price lower than that at which sources of substitute products could be profitably exploited.

Conclusions

Consideration of the foregoing facts, leads the writer to the belief that during the five-year period 1936–1940, we may expect:

1. An increasing demand for motor fuels, probably reaching a greater annual rate of consumption than any yet attained.
2. A slowly increasing demand for fuel oil, approaching and perhaps surpassing the former peak demand of 1929.
3. A slowly increasing demand for kerosene.
4. A slowly increasing demand for lubricants.
5. An increasing demand for crude, probably again reaching or even surpassing the record consumption of 1929.
6. The prospective demand for crude petroleum during the next five years can be readily supplied from the visible reserve in present-known fields.
7. Flush production from newly discovered fields will probably limit any serious drain on the visible reserve during this time.
8. Within the boundaries of the United States, there is probably a substantial reserve of petroleum as yet undiscovered.
9. The rate of discovery of new fields from the undiscovered reserve is likely to diminish rather than increase.
10. The visible supply of oil producible from present-known fields by ordinary methods of recovery, recently estimated at upwards of 12,000,000,000 bbl., is not likely to be greatly increased, and expressed in terms of years' supply is more likely to diminish.
11. Indications point toward a growing interest in and dependence upon the visible reserve in present-known fields producible by improved methods of recovery. This substantial reserve constitutes an important bulwark against future shortage of crude supply in the event of decline in the rate of discovery of new fields.
12. Large amounts of crude may be made available from the visible reserve producible by improved methods, but at a price substantially double that of present-day crude, and at a rate considerably less than the current domestic demand.
13. Very large reserves of materials from which substitute oil products can be manufactured, are available within the United States. Oil substitute products derived from them are however, inferior to petroleum products in quality and are producible only at a cost at least twice the present price of crude petroleum. It seems improbable that such products will be economically attractive during the next five years.
14. Both demand and supply factors presage a period of rising prices for petroleum and its products.
15. Our export trade in oil products is not likely to be greatly increased above present levels; rather, the United States is probably destined soon to assume the role of a debtor nation in the world's petroleum balance sheet.

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Hydrogenation in Spain

Following in the footsteps of Germany and Great Britain, the Spanish government is making a tentative effort to create a home motor fuel industry through the hydrogenation of native deposits of coal, oil shales and lignites. This resolve has been embodied in a law passed October 24, 1935, which creates a fund of 18,000,000 pesetas a year for a term of three years. The whole amount of this fund is not expected to come directly from the national treasury; according to the law C.A.M.P.S.A., the present Spanish petroleum monopoly, is to contribute as much to the fund "as it is able," the government making up the difference.

Strictly speaking, the 18,000,000 pesetas are to be used to pay for Spanish-produced synthetic fuel for army and navy requirements if, when and as made available by Spanish enterprises in this field. At present no such enterprises are in existence.

Meanwhile, Spanish experience with alcohol-gasoline motor fuel has proved disappointing. In June, 1935, a law was passed making it obligatory for the C.A.M.P.S.A. to purchase alcohol from beet molasses and wine distilleries for mixing with gasoline. The mixed fuel was evidently put on the market without adequate preparation. Although experience in neighboring countries with mixtures of anhydrous alcohol and gasoline have raised no technical difficulties, the mixture furnished by the C.A.M.P.S.A. was of so poor a quality that after an initial experience many drivers could not be induced to run on it again.

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Gasoline Substitutes in China

There are many "backwoods" regions in China where taxation and the high cost of transportation prohibit the extensive use of gasoline. At the same time attempts have been made for several years to increase the transportation facilities in these regions, especially by motor vehicle, and make more available the mineral and agricultural resources of the interior.

Consequently it has been found more economical to erect distilleries in certain localities for the production of power-alcohol from rice and maise. A number of these plants have been ordered from British firms in the past year or two for supplying motor fuel to municipal and other transport services.

In Hangchow, Nanking, Shanghai and other areas charcoal-gas generators have been installed on hundreds of buses, motor boats, agricultural machinery, and engines operating water pumps.

Growing Importance of Near Eastern Oil

Accessibility of Levant Makes that Source of Utmost Importance to Europe in a Possible Crisis—Supplies Arrive in Jerusalem for Second Iraq Pipeline.

By A. E. Mulford

JERUSALEM, DECEMBER 6

WHEN THE war clouds thundered out their dread warning over East Africa, the rumbling echoes might have been heard in the Levant. For, although Palestine and Iraq are as far away from Ethiopia as from Rome, the embroilment of the Near and Middle East in the economic consequences of the war, if not in the field campaigning, was a foregone certainty.

Sanctions are to be a part of the legislation of Palestine, Syria and Iraq, linked closely as they are with the policies of their Mandatory powers, England and France. The application of such measures in these Eastern territories will have a determining effect upon the situation.

For the East is now producing petroleum on a large scale. And the nations of Europe, particularly the belligerents, undoubtedly covet the supply.

During the five months ending March 1935, the Iraq oilfields sent off from the Haifa sea terminal alone a quantity of 692,302 tons of crude petroleum. The year's shipments, at this rate, will be around the 2,000,000 ton mark. It is by no means an inconsiderable figure: for should hostilities by some mischance assume a more general character than at present, it will be easier to get oil from the East, fringe of the Mediterranean, than from production centers much further afield, necessitating the running of ironclad blockade measures.

That is where the Levant would, on the one hand, score in point of accessibility; but, on the other, it would be the more vulnerable to attack. One of the first objectives of an enemy power against a country owning the monopoly over Eastern oil output would be the channels along which it is shipped.

Failing commercial access or military sequestration of such important supplies, it is obvious that the disgruntled enemy would wish to destroy so vital a communication. At the moment of writing, that may be a very remote probability, but it is one that no doubt figures in the strategic calculations of the European powers.

In times of peace, Europe looks to the oilfields of Iraq and the Middle East hinterland for more and more petroleum. And the tangle of political issues involved makes it more than likely that this untapped area should be under more than usual international scrutiny.

IN COMMON with the other governments through whose territory Mosul oil is being piped and handled, the Palestine Administration is finding the traffic a lucrative feature in its budget.

This new item on the port and shipping side of the accounts is for the dues being paid for the use of the oil dock at Haifa. The dock is on lease to the Iraq Petroleum Company, which pays 2d. (roughly 4 cents) per ton shipped and will pay 5d. (about 10 cents) per ton once the dock is completely constructed. This may possibly be before the end of the year.

The unloading of refined petrol for local use is charged for at the rate of 2d. per ton.

The Iraq Petroleum Company has undertaken to pay a minimum £P.30,000 per annum once the oil dock is fully complemented and equipped. The charter came into effect on October 26, 1934. From that date until the end of March of this year, the Palestine Government was paid £P.5,769 for port charges. Eventually the annual fee will amount to some £P.45,000.[1]

THE FORECAST that the giant pipeline across formerly untraversable desert would open up new avenues of development in the immemorial East has been fulfilled in part by the completion of the telephone line between Baghdad and Jerusalem. Linked across 600 miles of mountain plateaux and desert, Baghdad has been brought nearer to an ancient city than ever in their respective aeons of history.

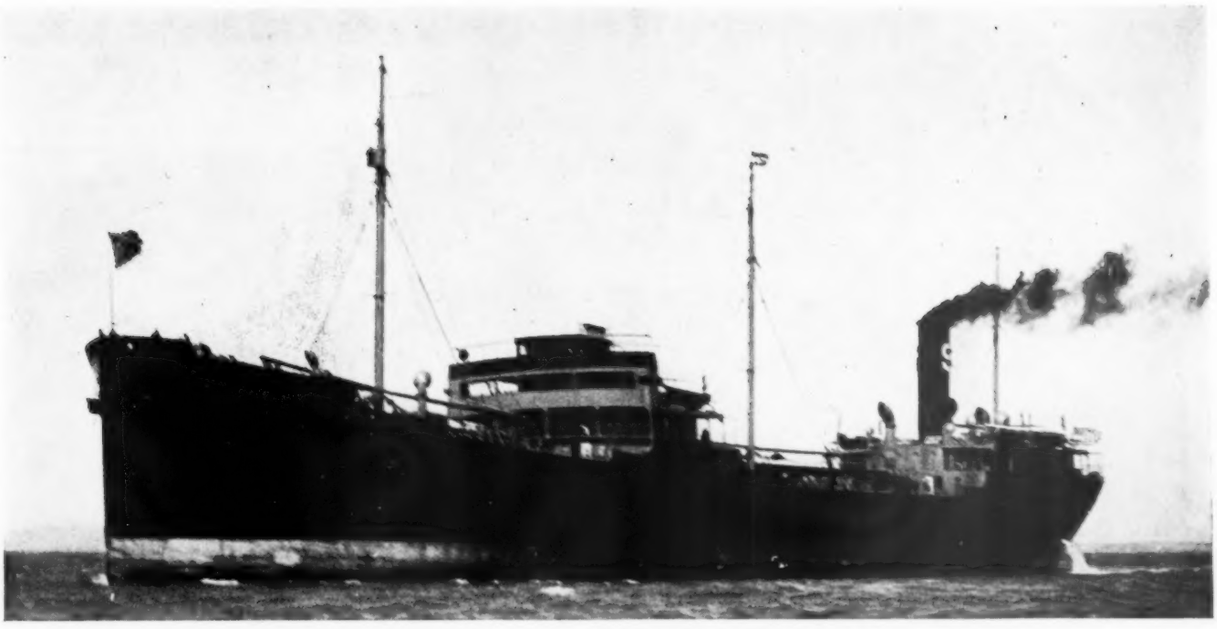
Another reported development is the planned construction of a railroad across the same route by the British Oil Development Company. Reports have indicated that the B.O.D. would find this method far less expensive than a pipeline and far more economical than shipment at Basra and round the Persian Gulf, up the Red Sea through Suez to the Mediterranean and Europe.

Should these communicating links come about, they would have the effect of developing an arid, uninhabited country—roamed only by scattered nomad tribes—more in line with the progressive régimes in the remainder of the East.

A parallel pipeline, to act as a reserve channel in case of emergency or when increased production is required, is to be laid down along the present route, it is learned. Large quantities of piping have already arrived at Baghdad for the purpose. As is known, the pipe from Kirkuk runs via Baghdad to Haditha, in the Syrian desert, one bifurcation then going south to Haifa, and the other straight across to the port of El Mina, at Tripoli.

[1] £P.1 (One Pound Palestine) = £1 sterling = 5 dollars.

General view of Haifa harbor, one of the principal gateways to the supplies of Near Eastern oil.



s s BAHREIN, tanker with a capacity of 7,095 gross tons formerly the s s R. J. HANNA. She will operate between Bahrein Island in the Persian Gulf and the Orient.

Bahrein Petroleum's Persian Gulf Refinery

Construction Work Being Expedited on New 10,000 Bbl. Plant on Bahrein Island—Design Permits Doubling Capacity If Required—British and American Engineers Employed.

FOLLOWING the disappointing results of the New York conference on the question of purchase of Bahrein and Eastern Saudi Arabian crude by several of the major oil companies, the Bahrein Petroleum Company Ltd. is proceeding actively with its plans for the construction of a 10,000 bbl. refinery on the island of Bahrein in the Persian Gulf. In fact, the work, which started in December, is being so expedited that it will probably be completed in six months. Perhaps this will prove a record for the building of so large a plant thousands of miles from manufacturing centers and at least 12,000 miles (almost exactly half-way around the world) from the company's headquarters. Arrangements are being made to facilitate doubling the size of the refinery at an early date if circumstances warrant.

Construction work is being carried out by experts from the Standard Oil Company of California's organization, loaned to its subsidiary, The Bahrein Petroleum Company, Ltd. Already about fifty British and American engineers and expert mechanics have been sent to Bahrein to take care of the erection of this plant and to train and direct local workmen. A 12 in. submarine line for loading crude was completed in 1933. This will be paralleled with another 12 in. line to make a double line system for loading all black oils. A second 8 in. and 10 in. double line system will be installed for loading white products. There will be no cracking units for the present.

Plans call for the erection of a 2,000 KW power plant consisting of three 250 KW Diesel sets and one 1,250 KW steam turbo-generator set. In addition prices are being obtained in the United States for three 200 hp gasoline engines for pump operation. It is evident that welding will be extensively used, as it is reported that one large order for welding equipment has been placed in America for shipment to Bahrein. The refinery tank farm will consist of 600,000 barrels of tankage installed with the usual fire protection equipment.

For several months officials of the Standard of California have been visiting European engineering works obtaining costs on certain equipment for this refinery.

An interesting development of the company's overseas operations is the recent formation in Great Britain of the California Standard Oil Company, Ltd. H. D. Collier has been appointed Chairman. Offices are at 6, Lothbury, London.

Drilling Campaign Authorized in Britain

Granting of Permits Covering Twelve Separate Areas Marks Beginning of Systematic Exploration to Determine Existence of Oil Deposits of Commercial Value.

Oil flowing from Hardstoft No. 1 in England on June 3, 1919. The well is now on pump for small production.

WITH THE granting by the British government of 30 drilling licenses covering an area of 5,400 square miles in 11 English counties, the way is opened for a systematic exploration of possible petroleum resources in the United Kingdom. The permits were issued to the D'Arcy Exploration Co. Ltd., a subsidiary of the Anglo-Iranian Oil Company, and are located in Surrey, Sussex, Hampshire, Dorset, Wiltshire, Yorkshire, Lincolnshire, Nottinghamshire, Leicestershire, Rutland, Cambridgeshire and Norfolk.

Some twenty other drilling applications are under consideration and permits for some or all of these are to be issued subsequently. When the areas covered by these licenses have been tested by the drill it is anticipated that a reasonably clear answer will be supplied to the much debated question whether Great Britain possesses indigenous oil deposits worth developing.

That expectations in this direction are not over sanguine is indicated by the following statement issued by the Anglo-Iranian Oil Company:

> After considering the scientific evidence collected by the geologists regarding the possibility of the existence in the United Kingdom of conditions favourable for the accumulation of petroleum, the company has decided that there is a sufficient case to justify investigation by test drilling, in addition to further geological and geophysical work.
>
> The geological conditions, in so far as they are at present known, do not suggest extensive deposits, but it is recognised that a special value would attach to indigenous oil, even if the discovery were limited to relatively small commercial quantities.
>
> The drill alone can determine whether or not such deposits do, in fact, exist.
>
> The company has acquired licences over a number of areas, and will begin its operations by drilling in the South of England. In certain other districts much geological and geophysical survey work remains to be undertaken, and a decision as to whether drilling is justified there will depend on the results of such work.

That oil is present in limited quantities in different parts of the United Kingdom is shown by the seepages which occur in the coal seams of various mines and in certain other places. As long ago as 1847 James Young, a Scotch chemist, paved the way for the world's mineral oil industries by refining oil obtained from a Derbyshire coal mine. When this supply was exhausted he succeeded in distilling oil from a certain type of coal found in the Lothians. Subsequently he turned his attention to the Scottish oil shales from which oil is still being produced by Young's Paraffin Light and Mineral Co. Ltd. of which he was the founder. The company is now associated with the Anglo-Iranian Oil Company, Ltd. through Scottish Oils, Ltd.

Following the world war, in 1918–19, an attempt was made by the Cowdray interests to discover oil by drilling. These activities were fully described by WORLD PETROLEUM in July, 1934. A well at Hardstoft was brought in, and in the intervening period has produced some 21,000 bbl. of oil. It is still in operation, yielding a high grade oil which commands a premium in the British market. In fact, the highest price ever paid for crude oil was made by the Anglo-American Oil Co. many years ago, because of its lube-oil content.

Previous to 1934 three licenses to drill for oil in England had been issued. The oldest of these, granted in 1923, was held by the Duke of Devonshire who had acquired ownership of the Hardstoft well. In 1930 a license was granted to Henry King Hiller, whose operations were in the locality of Heathfield, Sussex, where gas was obtained. A third license was issued in 1931 to the N. M. D. Syndicate which drilled to a depth of 2,000 ft. at Three Bridges, Sussex.

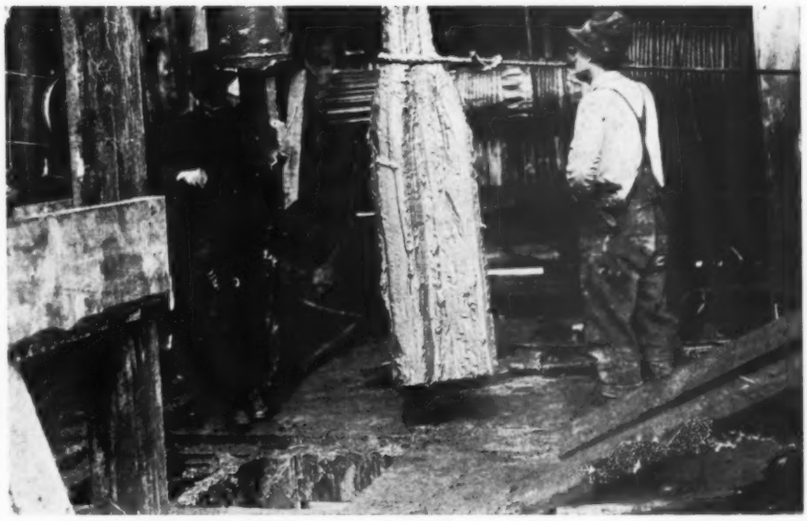
In 1934 Parliament passed the Petroleum (Production) Act which established the right of the nation to all oil resources within the country and established definite conditions to govern the granting of permits for exploration and drilling. This legislation stimulated renewed interest in the subject and a large number of applications were received. The drilling permits granted last November were issued under the terms of this law.

Among geologists, opinion inclines to the belief that while oil may be discovered in the United Kingdom, it will be found in small quantities and that no extensive field is likely to be uncovered. Speaking on this subject before the Oil Industries Club in London several months ago, Prof. V. G. Illing of the Imperial College of Science said that adequate source rocks exist in the British Isles and that this condition has been repeated several times in the geological record. The Middle Carboniferous and the Upper Jurassic were two good instances and others could be mentioned among the British Carboniferous rocks where the conditions of oil seepage and impregnation were as marked as in many a producing oilfield. Because of the severe folding, faulting and denudation to which these rocks had been

subjected since they had been laid down, however, the oil had all too many opportunities to escape and there is little hope of its preservation in the large quantities demanded for an important oilfield.

Prof. Illing said that in the eastern part of England it was reasonable to anticipate the presence of Carboniferous in gently folded conditions and with a suitable cover of plastic Mesozoic rocks which might have effectively sealed any oil or gas from leakage, except during Permian times, but stated that careful research was needed as so little was known about the structure of the Paleozoic in that part of the country.

As the permits that have now been issued call for drilling within a period of two years, all theories as to the existence and location of oil in the United Kingdom will shortly be put to the final test, that of the drill itself.



Cable tools on the Hardstoft rig in 1919. Production came in from 3,075 ft.

▼

Important Oil Action in Coming Session

Prohibition of Oil Shipments to Belligerents, Oil Production Regulation, Limitation of Imports and Other Questions Await Action by Congress.

By Don Kirkley

WASHINGTON, DEC. 20

CONGRESS and the New Year, opening together, bid fair to hold several months' of legislative action of national and international interest to the petroleum trade, a close range view as the pair arrive indicating:

1. That some limitation of imports, possibly to as low as around five percent of the domestic daily production, will be put into effect.
2. That Congress will authorize the Bureau of Mines to continue to make advisory allocation estimates for the producing states.
3. That the Connally hot oil law will be made permanent, perhaps with some modification to give the federal government authority to function in states that have no regulatory laws.
4. That no general control legislation is likely to get very far and that it is doubtful whether the usual advocates of such legislation will be very sympathetic toward it.
5. That Congress may, by a close vote and after sharp debate, slap an absolute prohibition down against the shipment of petroleum to belligerents.

These are the five major points most likely to hold interest during the next few weeks. Taking them up in the reverse order, consider Number Five for a moment and its volcanic international possibilities:

A very heavy majority of members of Congress are at heart deeply interested in efforts to keep America out of war.

Thus far in the preliminary consideration and discussion of this question, those most vitally interested, particularly the liberal or progressive group in the Senate, prefer not to make up their minds until the League powers and the other nations decide on a course of action and put it into effect.

President Roosevelt, who would like to see no oil traffic with warriors, probably will utilize very early in the session the strategy indicated in the last issue of WORLD PETROLEUM:

Get some of the Administration stalwarts, who will act just as if it were their own idea, to propose legislation giving the President discretionary authority to put any material on the contraband list for any nation. The present neutrality law would take in all nations at war and provides that the President cannot tell one country it can have what it wants while the other one can't.

The chances are that such a campaign would bog down against the small clique familiarly known as the "irreconcilables," a group of a dozen senators headed up by Johnson of California and Borah of Idaho, who won their title by blocking American adherence to the League and who have subsequently consistently fought any sort of a back door or side door entry as well as smashing down any front door opening.

On point Number Four—the issue of general control legislation of the type of the various Thomas, Disney, Margold, Ickes, and other bills, it appears likely that there won't be any while the industry continues its present prosperous operations.

Extension of the Connally law on a permanent basis is considered assured if the question comes up, and it is expected to be brought up. Along with it will be issues Number Two and One: continuation of advisory production estimates and limitation of imports.

Number Two will be easy and without argument. Number One will be neither but probably will be effected. The underground story, clothed with more than the usual amount of authenticity, is that President Roosevelt has agreed actively to support legislation for limitation.

Impractical Aspects of Japan's Oil Law

Effect of Japan's Oil Law in Practice on International Oil Companies on Whom She Relies for Future Supplies Indicates Necessity for Further Modification.

By W. Harvey Clarke

TOKYO, DECEMBER 1935

THE Japanese Government's drastic oil policy, currently in effect, made 1934–35 one of the really eventful periods in the annals of the empire's petroleum industry. The policy—primarily military—was designed to modify some of the disadvantages imposed upon Japan by the country's limited domestic oil resources. Its first purpose was to promote development of domestic refining, and it set out to accomplish this end by establishing sales quotas for both refiners and importers, the former being given the greater share of the natural increase in the empire's demand. Its secondary aim was to force refiners and importers to keep in storage a six months' supply of imported petroleum and petroleum products.

Quite naturally, the Socony-Vacuum Corporation and the Rising Sun Petroleum Company, the two major factors in this market for years, resented the legislation. In 1934 Japanese authorities were flooded with notes of objection from the American, British and Dutch Governments in the attempts of international interests to reconcile conflicting standpoints. But Japan remained immovable. Prolonged conversations between international oil men and authorities of the Ministry for Commerce and Industry resulted in certain modest concessions. Notes from other governments brought replies only after protracted delays, during which the Foreign Office spokesman viewed the situation in a spirit of levity. Japan has maintained its stand that the nation's oil policy is strictly a domestic issue, that other governments have as little right to interfere as they had when France and Italy drafted similar laws, and that international concerns in Japan must agree to abide by the provisions of the law or withdraw. The international firms seem to have decided to stay in the market, but it is understood that their decision is merely tentative.

Effective on April 1, oil concerns were compelled to store a three months' supply of imported petroleum, and after October 1 a six months' supply was required. Domestic oils need not be stocked. This requirement calls for capital expenditures of between 40,000,000 and 60,000,000 yen ($33,600,000–$50,400,000, U. S.) for building tanks and for stored petroleum, with interest charges ranging from 2,000,000 to 3,000,000 yen ($1,680,000–$2,520,000, U. S.) annually. The government did not move to assume any part of this expense, and until December 28, 1934, would not permit oil concerns to raise prices to help cover the cost. As detailed below, they were permitted to raise the maximum gasoline price by 3½ sen (2.9 cents U. S.) a gallon. No minimum price having been set and the figure not being high enough for profitable operation by more than two or three of the companies in the market, the position was far from reassuring.

It is understood that Socony-Vacuum and Rising Sun representatives, who negotiated with the Commerce and Industry Ministry, succeeded in getting two concessions. The first was an agreement that they would be given a fair share of the increased demand. In the quotas assigned for the latter half of 1934 (given hereunder) they received practically none of it. In the quotas for 1935 they were given a little less than a third of the increased demand. It is further understood that, in the future, they may receive almost half. But—and here is where the second concession becomes valuable—they contended that a rising share in the market would necessitate continuing investments for additional tankage. Thus it is said that the authorities consented to let these two companies base their six months' supply not upon a possibly large share of the market in future years, but on 1934 sales.

Gasoline Sales Quotas

(In 10,000 cases)

Companies	Quota for Second half of 1934	Actual sales for First half 1934
Rising Sun Petroleum	3,960	3,850
Socony-Vacuum*	2,640	2,630
Matsukata-Nisso	660	...
Nippon Oil	3,532	2,865
Ogura Oil	1,848	1,260
Mitsubishi Oil	1,320	825

* Quota for General Petroleum, imported by Mitsui Bussan Kaisha, is included in the Socony-Vacuum quota, as General is a Standard Oil subsidiary.

The new oil law permits the government to control imports, annual production, annual sales and to determine maximum prices. When the law became effective in July, 1934, the quotas shown in the preceding table were assigned.

It will be noted that the original quotas under the new law gave the greater share of the market increase to Japanese refiners. Just as soon as these quotas became effective, all domestic refiners applied to the authorities for permits to construct new refineries. The Commerce and Industry Ministry waited three months before answering and then advised the Japanese concerns to postpone activities a year or more. Conditions are still unsettled and the authorities would have a state of more tranquillity before authorizing additional capacity.

Discord arose in oil circles more than a year before the new law went into force, when in July, 1933, the initial shipment of Soviet gasoline entered Japan through the Matsukata-Nisso Oil company (Nisso meaning Japan-Soviet). This organization sought admission to the oil cartel, which then consisted of six companies—Rising Sun Petroleum (a Royal Dutch-Shell subsidiary), Socony-Vacuum, Nippon Oil, Ogura Oil, Mitsubishi Oil and Mitsui Bussan Kaisha. The provisions of the Soviet Oil interests were rejected. Socony-Vacuum and Rising Sun interests declined to permit Soviet gasoline to enter the cartel. The objection, it appeared, was based upon Soviet confiscation of properties belonging to both companies following the revolution in 1917. When Kojiro Matsukata entered the market, the gasoline price was 50 sen (42 cents U. S.) a gallon. The two international concerns began to cut prices in an effort to retain their position in the market. The price fell to 35 sen (29 cents U. S.) a gallon, but still he was going strong. He was admitted to the cartel in July, 1934, and prices rose to 40 sen (34 cents U. S.) a gallon. The member companies wanted to boost them to 50 sen, (42 cents U. S.) as formerly, but the Commerce and Industry Ministry would not hear of it. Heavy oil was given a maximum price of 45 yen ($37.80 U. S.) a ton, machine oil (lubricating) 3 yen ($2.52 U. S.) a case and kerosene 4.50 or 5 yen ($3.78–$4.20 U. S.) per case, depending on grade.

Close upon the heels of this settlement, the two international concerns withdrew from the cartel, protesting the quotas shown above and the Oil Business Law in general and commenced to unload as much gasoline as possible on the market, lower-

ing prices to do so. The fundamental objective, it seemed, was to sell an excessive volume of oil as the basis for higher future quotas and to undersell Japanese concerns (which already felt more than slightly shaky from eight months of intensive shedding), so that their outcries would compel the authorities to formulate a more practicable and equitable arrangement. Their policy was relatively successful to the extent that the subdued outcries of domestic refiners at last rose to such persistent clamors that the Commerce and Industry Ministry on December 28, 1934, conceded to a 3½ sen (2.9 cents U. S.) a gallon raise in the official price, as a compromise. Minister Chuji Machida had publicly promised, due to pressure from truck and taxicab operators, that the price of gasoline would not be raised. Yet counter-pressure from domestic refiners grew to such proportions that he was forced to capitulate. They were demanding the right to charge 50 sen (42 cents U. S.) again, the price of 18 months previous.

As there was nothing to compel any concern to charge the maximum price, filling station quotations stood at about 42 sen (35 cents U. S.). However, this accounts for a relatively unimportant portion of gasoline sales, for most of the suppliers' business in Japan consists of independent contracts with truck and taxicab owners who operate fleets. Prices quoted to them are invariably 4 and 5 sen under those at filling stations.

When the compromise price jump was granted by authorities of the Ministry, a statement was issued for the benefit of the press that, as the annual gasoline demand approximates 270,000,000 to 280,000,000 gallons, oil company "profits" should mount by 9,600,000 yen or so. With nearly all oil concerns in Japan taking losses at the existing level of prices, such "profits," should they appear, would forthwith become unexpected phenomena.

Authorities of the Commerce and Industry Ministry on December 27, 1934, assigned new sales quotas for 1935. In oil circles they were credited with extreme subtility in the manner in which they determined the figures. First, 1935 gasoline demand was estimated considerably above any probable figure, allowing for an increase of 15 percent, or 150,000 kiloliters, over the level of 1,000,000 for 1934. Then, 105,000 kiloliters of this increase was allowed to domestic refiners and the remaining 45,000 kiloliters to importers. This is said to have been done to "keep the foreigners quiet," so any charges of unfairness made in ensuing conversations could be countered. The result was that importers sold their quotas, or even exceeded them, and domestic concerns had to accept voluntary cuts in their quotas. Quotas were assigned as follows:

1935 Oil Sales Quotas

(In kiloliters)

	Refiners	Importers	Total
Gasoline	583,000	567,000	1,150,000
Kerosene	83,500	65,000	140,000
Light oil	191,000	9,000	200,000
Machine oil	252,500	37,500	290,000
Total refined	1,110,000	678,500	1,788,500
Crude	183,000	1,067,000	1,270,000*

* Including 20,000 to be imported directly by consumers.

Gasoline Quotas for 1935

(In kiloliters)

Nippon Oil	270,500
Ogura Oil	150,500
Mitsubishi Oil	101,000
Hayama Oil	30,000
Niitsu Oil	19,731
Aikoku Oil	10,000
Maruzen Oil	1,300
Others	197
Total Refiners	583,228
Rising Sun Petroleum	310,500
Socony-Vacuum	205,000
Mitsui Bussan	51,000
Marukawa (importing from Texas Company)	150
Total Importers	566,650

It should be noted that Aikoku and Hayama oil, two of the three large independents, agreed to join the gasoline cartel.

Kerosene Quotas for 1935

(In kiloliters)

Nippon Oil	24,500
Ogura Oil	26,868
Mitsubishi Oil	6,500
Hayama Oil	6,260
Niitsu Oil	9,000
22 Others	10,561
Total Refiners	83,689
Rising Sun Petroleum	29,520
Socony-Vacuum	26,970
Total Importers	56,490

Gains by domestic refiners that have been reflected and magnified in the 1935 quotas are indicated in the table below:

Shares in the Japanese Oil Market

(In percentages)

	—Refiners—		—Importers—	
	1935	1930	1935	1930
Gasoline	50.7	41	49.3	59
Kerosene	59.6	27	40.4	73
Light oil	95.5	66	4.5	34
Machine oil	87.1	75	12.9	25

Japan's domestic oil production is negligible. In 1934 it reached only 210,748 tons, just about enough (considering the gasoline content) to supply the nation's motor vehicles for 15 days. The output of the North Sakhalin field—which is owned by the Soviet Union but is operated by Japanese—in 1934 rose approximately 20,000 tons. Figures follow hereunder:

© Wide World

Japanese preparing to blast oil slate beds in Manchuokuo where work is being pushed forward in an effort to add to oil supplies controlled by Japan.

Japanese Oil Production*

(In tons)†

	All Japan including Formosa	Including North Sakhalin
1922	278,957	278,957
1923	257,349	257,349
1924	257,829	257,829
1925	265,567	265,567
1926	257,535	287,364
1927	247,143	325,843
1928	285,415	407,415
1929	291,100	476,100
1930	277,609	470,649
1931	280,877	467,877
1932	241,525	428,525
1933	205,105	355,105
1934	210,748	382,850

* Nippon Oil Company figures with exception of that for Russian Sakhalin, which is from the North Sakhalin Oil Company.

† A ton is considered equal to 7 barrels containing 42 American gallons.

Fluctuations of Oil Prices in Japan

(Crude in yen per koku of 48 gallons)

	—Niitsu—		—Higashiyama—	
1922	18.50	11.00	20.00	12.50
1923	13.70	11.00	13.00	12.00
1924	14.00	12.30	15.20	13.25
1925	12.30	9.25	14.20	11.50
1926	10.00	9.30	12.50	11.40
1927	9.20	9.00	10.40	9.30
1928	9.30	8.10	9.80	9.00
1929	8.50	7.75	9.80	9.00
1930	7.50	6.30	9.40	7.00
1931	5.80	4.70	7.00	5.30
1932	6.80	4.70	8.30	5.30
1933	8.30	6.10	10.10	7.00
1934	6.85	6.30	7.30	6.50

Foreign Oil Legion

COMM. RAG. MARIO PETRUCCI has been appointed as chairman of the Soc. Anon. Italiana "Vacuum Oil Company" of Genoa, and, together with Comm. Rag. Pietro Mambretti, as managing director of the company.

DR. MANUEL ARCHILA, after an extended stay in the United States during which he visited all important refinery and production centers, is returning to Bogotá. Dr. Archila graduated from the National University in Colombia and later pursued graduate study in petroleum engineering at the Colorado School of Mines where his distinguished record gained him election to the honorary engineering fraternity Tau Beta Pi. As former national comptroller of the petroleum division and technical adviser to the Colombian government he obtained an intimate experience with both the technical and legal phases of the petroleum industry in the country. Because of this background his services were invaluable in assisting the commission of five outside experts which the Colombian government invited for the purpose of drafting an adequate petroleum law.

Dr. Manuel Archila

MARTIN W. STRONG of Anglo Iranian Oil Company is making a detailed study of American drilling methods with particular attention to the use of weighting materials in deep drilling. He visited Texas fields prior to the A.P.I. Convention which he attended and thereafter toured fields in the Los Angeles Basin and in Central California. He also went to San Francisco in company with Mr. Cox of Western Gulf and among other calls visited the factory of C. K. Williams and Company, where he discussed the values of various weighting materials with V. Frazee.

J. PH. VAN GOETHEM, general manager of the "Diadema Argentine" S. A. de Petroles (Royal Dutch-Shell group) has recently completed his 25th year of service. Two pictures painted by a Bataafche artist were officially presented to Mr. van Goethem, one of which was signed by a large number of his Dutch colleagues, including Mr. J. E. F. de Kok.

C. M. CLAEYS, general export manager, The Texas Company, and M. Herron, manager European refinery operations, are visiting London.

ROGER HENQUET, California manager for Schlumberger Oil Well Surveying Company, left New York on December 7 aboard the Ile de France for his first visit to France since his appointment to take charge of the California office of his company. Mr. Henquet is accompanied by his wife and two and a half year old daughter, Nadine.

H. ROBERT SWANSON, vice president of Alco Products since 1930, has recently been appointed vice president in charge of sales and engineering according to an announcement made by Joseph Davis, president. Kirby K. Wyatt has been appointed general manager and John H. Erter has been appointed assistant general manager.

G. H. HAMMERSLEY, London Representative of Continental Emsco Company and Youngstown Sheet and Tube Co., has left for New York on a visit.

GERALD H. DILLON, well known in the oil industry both in the United States and Europe, has opened an office at 30 Church Street, New York City, where he will act as an agent and broker for the purchase and sale of petroleum and petroleum products. His association with the oil industry dates back to the early days in Tulsa where he opened and established a sales office for the Bethlehem Shipbuilding Corporation, taking charge of design and sales of Paraffine Wax Plants and equipment for the mid-continent territory. Before going to Tulsa he was Production Engineer for refinery equipment at the Moore Plant, Bethlehem Shipbuilding Corporation at Elizabethport, New Jersey. Leaving Tulsa he was placed in charge of refinery equipment sales for the entire country at Bethlehem, Pa. and New York City.

Resigning in 1926 he became associated with the Walter E. Lummus Company of Boston to promote the development and sales of continuous fractional distillation and the Coubrough Process which that company was then pioneering in the oil industry. In 1928 he was appointed sales manager of the company and continued in that capacity after the Lummus Company was acquired by the Babcock and Wilcox Co. and Superheater Company interests, resigning this year to establish his own business.

Gerald H. Dillon

Blank & Stoller

World Oil Production—Official Figures for 1934 and 1935 Revised

All figures furnished direct to WORLD PETROLEUM by Governments, except where otherwise specified

(Figures in U. S. Barrels—Conversion ratio 7 bbl. = 1 ton)

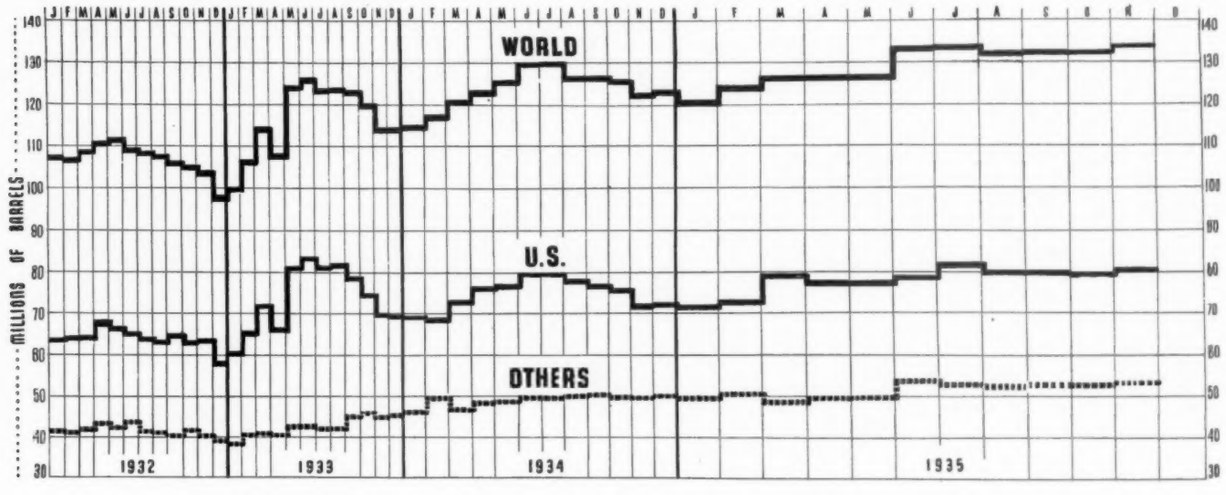
Country	December 1934	January 1935	February 1935	March 1935	April 1935	May 1935	June 1935	July 1935	August 1935	September 1935	October 1935	Provisional Figures November 1935
United States	74,772,000	78,715,000	72,763,000	81,488,000	78,427,000	82,454,000	82,338,000	85,485,000	84,816,000	84,109,000	88,160,000	80,233,230
Russia	14,658,400	13,358,000	12,704,300	14,139,300	14,058,200	15,248,800	14,232,400	14,050,000	14,230,000[1]	14,318,000[1]	15,160,000[1]	15,350,000
Venezuela	12,420,296	12,818,414	11,287,605	11,703,825	11,869,900	12,175,022	13,075,118	13,429,885	12,628,067[1]	13,151,362	13,681,619	13,152,776
Iraq[5]	12,006,127	425,000	1,631,000	2,258,123	556,500[1]	1,085,000[1]	4,200,000[1]	1,739,348[1]	1,739,255[1]	1,966,524	1,739,348[1]	1,683,240
Roumania	5,522,000	5,355,000	4,860,000	5,256,000	5,008,000	5,035,000	4,842,000	5,075,000	5,030,000	4,932,000	5,181,000	4,989,210
Iran[2]	4,049,556	4,410,714	4,109,665	4,879,000	4,088,000	3,927,000	4,200,000	4,249,000	4,634,000	4,270,000	4,109,000	4,260,150
Mexico	3,425,314	2,894,167	2,661,632	3,519,148	3,120,035	3,529,659	3,453,871	3,573,632	3,570,908	3,442,259	3,461,457	3,271,290
Netherland India	3,742,810	3,618,272	3,244,717	3,539,564	3,438,848	3,517,360	3,463,061	3,531,857	3,699,430	3,661,259	3,767,596	3,528,889
Colombia[4]	1,554,172	1,653,647	1,141,696	1,466,821	1,377,299	1,486,896	1,518,460	1,639,054	1,567,307	1,555,676	1,623,372	1,582,952
Argentina	1,173,998	1,114,235	1,107,420	1,260,468	1,514,968	1,203,017	1,161,638	1,198,550	1,198,537	1,152,919	1,252,617	1,205,730
Peru[6]	1,420,247	1,418,320	1,269,077	1,395,532	1,329,215	1,451,436	1,414,588	1,448,225	1,442,565	1,448,133	1,493,236	1,343,848
Trinidad	930,877	915,220	843,619	919,848	899,946	953,108	972,904	988,341	1,003,382	992,445	1,015,492	1,078,957
British India	746,410	781,170	708,159	773,572	756,461	794,968	768,692	700,000[1]	700,000[1]	711,360[1]	760,182[1]	735,650
Poland	308,000	307,000[1]	297,000[1]	309,000[1]	330,000[1]	340,000[1]	314,490[1]	324,973[1]	274,040[1]	308,220[1]	318,494[1]	308,220
Brunei	258,909	269,794	241,927	264,390	267,603	277,550	269,290	283,430	281,400	256,480	233,310	242,900
Sarawak	158,200	183,300	136,500	152,250	151,067	155,400	150,850	151,830	154,000	145,600	148,400	141,400
Japan	131,059	171,441	151,797	164,174	167,728	154,150	144,160[1]	146,863	152,290	144,312	158,165	151,429
Egypt	115,731	112,147	100,086	104,419	94,955	100,555	99,260	103,488	104,937	100,954	103,341	96,495
Ecuador	140,000	147,315	139,555	151,366	145,212	147,245	137,806	144,812	135,549	138,986	147,449	143,518
Canada	117,113	124,654	111,545	120,537	108,506	122,636[1]	120,102	118,812	117,652	123,919	122,525	117,330
Germany	228,767[3]	287,518[3]	223,153[3]	277,942[3]	240,464[3]	285,747[3]	257,369[3]	276,990[3]	241,801[3]	229,712[3]	232,659	255,330
France	46,000[1]	43,078	34,510	44,191	46,284	46,991	46,000[1]	45,276	46,312	43,530[1]	44,981[1]	43,530
Others[1]	75,000	75,000	75,000	75,000	75,000	75,000	75,000	75,000	75,000	75,000	75,000	75,000
Total	137,981,986	129,198,406	119,842,963	134,262,470	128,071,191	134,566,540	137,255,059	137,779,866	137,842,432	137,277,650	142,989,243	133,991,084

[1] Estimate. [2] Anglo-Iranian Oil Co. figures revised; fuel oil returned to the ground has been deducted. [3] Thuringia estimated 7,000 bbl.; official figure for Prussia. [4] International Petroleum Company's figures. [5] Iraq production estimated for 1934 on basis of total year's production represented by oil shipments through Tripoli and Haifa starting January 1935 plus oil necessary to fill line initially. [6] International Petroleum Company and Lobitos Oilfields Ltd. figures.

Russian Sakhalin included with Russia. Japanese Sakhalin included with Japan.

Official Crude Oil Production for 1932 to 1935

Country	Total 1935 to November 30	Daily Average 1935 to November 30	Total 1934	Daily Average 1934	Total 1933	Daily Average 1933	Total 1932	Daily Average 1932
United States	898,988,230	2,691,582	909,107,000	2,490,704	898,874,000	2,462,670	785,159,000	2,145,243
Russia	156,849,000	469,608	168,648,700	462,051	149,901,900	407,950	149,719,000	409,070
Venezuela	138,973,593	416,089	142,072,329	389,239	120,882,802	331,186	119,596,512	326,766
Iraq	19,023,338	56,956	71,921,468	6,607	1,200,000	3,288	1,200,000	3,300
Roumania	55,563,210	166,357	62,006,000	169,879	50,971,200	139,647	50,491,205	137,954
Iran	47,136,529	141,127	52,663,782	144,284	49,581,280	135,840	45,122,455	123,285
Mexico	36,498,058	109,275	38,167,022	104,567	33,904,882	92,890	32,802,285	89,624
Netherland India	39,010,853	116,799	42,289,408	115,861	38,512,663	105,516	39,584,027	108,153
Colombia	16,613,180	49,740	17,340,724	47,509	13,157,127	36,047	16,384,956	44,768
Argentina	13,370,099	40,030	14,045,652	39,015	13,759,565	38,232	13,166,900	35,975
Peru	15,454,175	46,270	15,936,937	43,663	13,923,281—	38,146	9,899,266	26,026
Trinidad	10,583,262	31,686	10,894,363	29,847	9,560,039	26,192	10,023,780	27,387
British India	8,190,224	24,522	8,997,399	24,650	8,721,655+	23,893	8,600,312	23,500
Poland	3,431,437	10,274	3,697,617	10,130	3,858,085—	10,570	3,905,230	10,670
Brunei	2,888,074	8,647	2,673,041	7,323				
Sarawak	1,670,597	5,002	1,948,044	5,337	2,289,472—	6,273	2,274,043	6,213
Japan	1,706,509	5,109	1,484,962	4,068	1,377,761	3,827	1,575,333	4,375
Egypt	1,120,637	3,356	1,479,037	4,052	1,591,495	4,360	1,742,370	4,760
Ecuador	1,578,813	4,727	1,655,062	4,534	1,622,624—	4,446	1,573,857	4,300
Canada	1,308,218	3,917	1,418,810	3,887	1,147,825—	3,144	1,054,373	2,880
Germany	2,808,685	8,409	2,266,964	6,211	1,712,823	4,692	1,824,019	4,983
France	484,683	1,451	552,000	1,512	552,000	1,515	552,000	1,508
Bahrein			285,071	781				
Others	825,000	2,470	861,000	2,359	432,000	1,184	432,000	1,180
	1,474,076,404	4,413,403	1,502,617,452	4,117,293	1,417,534,489	3,884,022	1,296,712,823	3,544,940



World crude oil production trend by months, 1932–1935. Chart is weighted to compensate for variation in number of days per month. Ratio of U. S. crude production to world production.

UNITED STATES

	Daily Crude Oil Production bbl.	Daily Runs to Stills bbl.	Total Motor Fuel Stocks bbl.	Imports for week bbl.	California Shipments East for week bbl.
Week ending Nov. 2	2,828,500	2,725,000	51,571,000	928,000[2]	234,000
	459,500[1]				
Week ending Nov. 9	2,816,000	2,695,000	50,766,000	1,039,000[2]	none
	457,000				
Week ending Nov. 16	2,873,000	2,780,000	51,697,000	438,000[2]	159,000
	459,000[1]				
Week ending Nov. 23	2,861,500	2,765,000	51,855,000	1,264,000[2]	214,000
	458,000[1]				
Week ending Nov. 30	2,837,000	2,825,000	53,128,000	447,000[2]	147,000
	451,000[1]				
Week ending Dec. 7	2,805,000				
	448,000[1]				

Underlined figures indicate improvement in statistical position—decrease in production, runs to stills, gasoline stocks and imports.

[1] Estimated total production of the East Texas field, official and unreported.

[2] Import figures include all oil imported, for domestic use and in bond for re-export, it being impossible to make the separation in weekly statistics.

General Developments

DURING the past month there were no important developments affecting the oil industry in Washington, D. C., and none are anticipated until Congress reconvenes in January and until the United States Supreme Court renders decisions on the matters pending before it now, including particularly the pending suits on the constitutionality of the Utility and of the Guffey Coal Bills.

The United States Bureau of Mines came in for much criticism within the last two months because of its very conservative production quotas for the principal oil producing states, quotas so low that current production is some 300,000 bbl. in excess of the recommendations of the Bureau. This conservatism undermined the position of this federal agency and for the first time the Texas Railroad Commission granted an allowable 55,000 bbl. per day in excess of the state's quota for the month of December.

In Texas the position of the Texas Railroad Commission was further strengthened by several court decisions including: (1) the decision of federal judge B. C. Dawkins in Shreveport, Louisiana, holding the Connally "Hot-Oil" Bill valid and constitutional; (2) the refusal of a three judge federal court in Houston to compel the Railroad Commission to permit transportation of waste or fugitive oil unless it is shown that the oil has been produced in accordance with conservation regulations; and (3) the ruling of the State Supreme Court in Austin that the Railroad Commission has the power to prescribe rules for spacing of oil wells and for granting exceptions to those rules, provided vested rights are reasonably protected so as to prevent the invasion of property rights. This latest decision, while upholding the Texas Railroad Commission in its practice of granting exceptions to spacing rules, opens the way to change in proration allowable in the East Texas field to permit proportionally larger allowables for wells located on larger tracts.

In the producing branch of the industry, due to favorable statistical position and to maintenance of uniformly high prices in motor fuel retail trade, a strong movement for increased crude oil prices early next year was apparent, while in East Texas field producers were attempting to persuade the Texas Railroad Commission to raise the allowable of the field from 450,000 bbl. to 600,000 bbl. per day. The oil industry was thus indirectly confronted with the decision of either allowing producers a small increase in price, and thus satisfying them, or having to dispose of 100,000 to 150,000 bbl. of excess production from the East Texas field. This problem was due to be partially solved at the December meeting of the Railroad Commission. In Oklahoma, the Fitts area, with the new discovery at Jesse, assumed major proportions, while Rodessa field in Louisiana was further extended. The production in Michigan declined from 1,742,000 bbl. in October to 1,468,000 bbl. in November, a decline of 274,000 bbl., due entirely to the lack of development of new reserves. Hence it appears probable that in view of the large refinery construction program undertaken in that state early in 1935, failure to develop new sources within the state will result in the necessity of bringing crude oil from outside the state to fill the requirements of the refineries, which may not be possible in the case of smaller units which could not stand the transportation expenses from the Mid-Continent area.

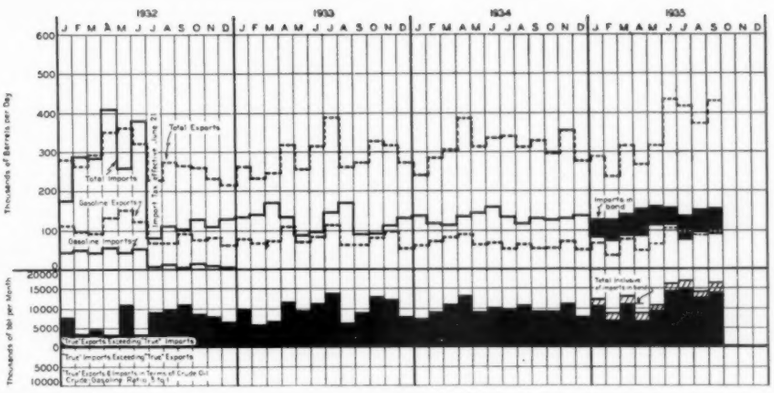
Prices Strengthened

DURING the past thirty days the crude oil and gasoline prices strengthened considerably throughout the United States, with crude oil advancing slightly in California and Pennsylvania, while premiums were being paid for East Texas connections. Similarly, retail motor fuel prices improved fractionally in many marketing centers on the Pacific Coast and in the eastern marketing areas. These developments, coming in the season of slackening demands, indicate the favorable statistical position of the oil industry and if markets continue at the present levels into 1936, a small advance in crude oil prices may be anticipated early in the year. Politically, such an advance, however small, will be an important factor in preventing any serious complaints reaching the next session of the Congress and consequently may help to avoid consideration of any federal legislative measures affecting the oil industry. The exports from the United States continued in large volume, thus helping to sustain the markets. In the production end of the industry several important developments occurred, but the increased demand more than took care of increasing potentials and, in fact, it is beginning to be increasingly evident that estimates of potential production in several states are excessive and it is not at all improbable that even within the next few months some states will be unable to maintain their present rate of production. The developments in the East Texas field continued favorable, with "hot-oil" production being kept minimal.

During the last month refinery gasoline quotations remained firm and unchanged for the sixth month in succession, excepting for a brief period of slightly lower quotations at the close of November. Natural gasoline quotations, after losing about three-quarters of a cent per gallon at the close of October and early in November, regained most of the ground lost early in December, while the new natural gas regulations promulgated in Texas recently will result in further strength.

Posted crude oil prices during November and early December remained firm and unchanged at $1.00 per barrel for 36 gravity Mid-Continent crude and $1.00 flat per barrel for East Texas crude, where a 5-cent premium was reported being offered for connections in excess of 4,000 bbl. per day. In California the Standard Oil Company of California advanced crude oil prices, effective December 6th, the increase in prices running from 10 to 21 cents per barrel, as indicated on the accompanying table. Effective November 20th, a second advance within one month was posted in Pennsylvania, raising Bradford crude oil to $2.30 per barrel and the Pennsylvania grade oil in Eureka pipe lines to $1.97, an increase of 15 cents per barrel.

Tank wagon/service station motor fuel prices per gallon, regular grade, including all taxes, in representative districts in the middle of December were: 15.25/19.5 cents in metropolitan New York (up 0.2 cents per gallon); 13.8/17.3 cents in Newark, N. J. (up 0.3 cents per gallon); 13.5/17.0 cents in Boston, Mass. (up 0.5 cents per gallon); 12.5/16.0 cents in Providence (up 0.5/2.5 cents per gallon); 14.0/16.0 cents in Chicago; 17.0/19.0 cents in Ohio; 14.0/16.0 and 13.5/15.5 cents in San Francisco and Los Angeles respectively, with independents gradually meeting higher quotations posted by the major oil marketers; 16.0/18.0



Total U. S. imports and exports and gasoline exports, indicating imports in bond; and showing evaluation of true exports exceeding true imports.

cents in Oklahoma; 15.0/17.0 cents in Dallas and Fort Worth and 16.0/18.0 cents in Houston, Texas, with third grade gasoline in the East Texas area advancing to 12 and 13 cents per gallon at independent service stations, from 10 cents quoted previously; 15.2/17.2 cents in St. Louis; and 20.5/23.0 cents in Montreal, Canada; all with a 2-cent differential for premium grade.

Refinery gasoline quotations in the Mid-Continent area remained firm and unchanged during the last 30 days. Refinery gasoline was quoted on December 10 at 4¾–4⅞ cents per gallon for 58–60 U.S.M. grade 62.9 and below octane rating in Group 3, Oklahoma market; 63.0–70.9 octane rating, U.S.M., regular grade, was quoted at 5⅝–5⅞ cents per gallon; and 71 and above octane rating, U.S.M., premium grade was nominally quoted at 5¾–5⅞ cents per gallon. East Texas markets continued firm with prices on par or ⅛ of a cent per gallon under Group 3 quotations; third grade product, restricted to intrastate markets not having approved federal tenders, was quoted at around 2½ to 3 cents per gallon. On the East Coast at Bayonne, U.S.M., grade 60.0–64.9 octane rating gasoline advanced ¼ of a cent per gallon to 6 cents per gallon (3.54 cents gold*). Gulf Coast prices for export advanced ¼ of a cent per gallon during the past month, reaching 5¼–5⅜ cents per gallon (3.17 cents gold*) for grade 58–60 U.S.M. by December 10.

Natural gasolines advanced ½ a cent per gallon during the past month, influenced by forthcoming stabilization of production in the Texas Panhandle and North Texas areas. On December 10 grade 26–70 was quoted at 4¼ cents per gallon (2.51 cents gold*) in Oklahoma; at 4 cents per gallon (2.36 cents gold*) in North Texas; and at 4½ cents per gallon (2.66 cents gold*) in North Louisiana.

Kerosene prices continued firm during the past month. On December 10 grade 41–43 w.w. was quoted at 3¼–3⅜ cents per gallon in Group 3, Oklahoma market; and at 5¼ cents per gallon (3.10 cents gold*) on the East Coast at Bayonne, an advance of ½ a cent per gallon. Gulf Coast prices for export also continued firm and unchanged at 3⅞ cents per gallon (2.29 cents gold*) for 41–43 p.w. grade and at 3⅞–4 cents per gallon (2.36 cents gold*) for 41–43 w.w. grade.

*** U. S. Dollar at 41 percent discount.**

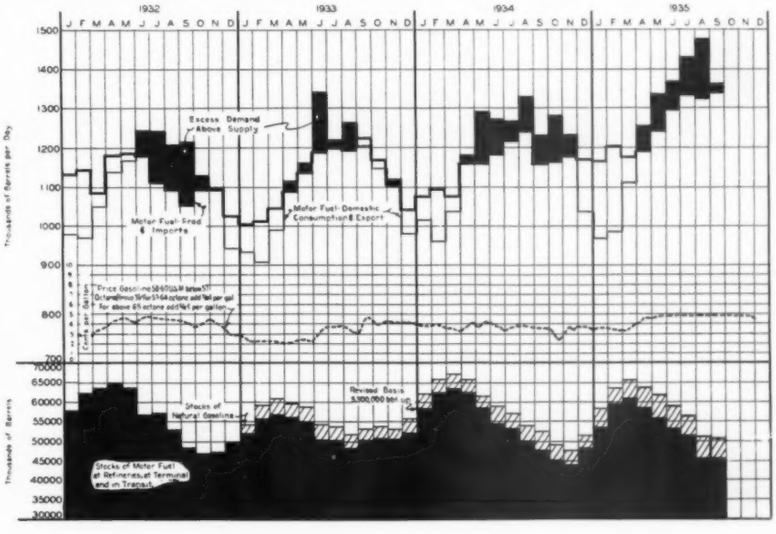
$162,066,838 Favorable Trade Balance

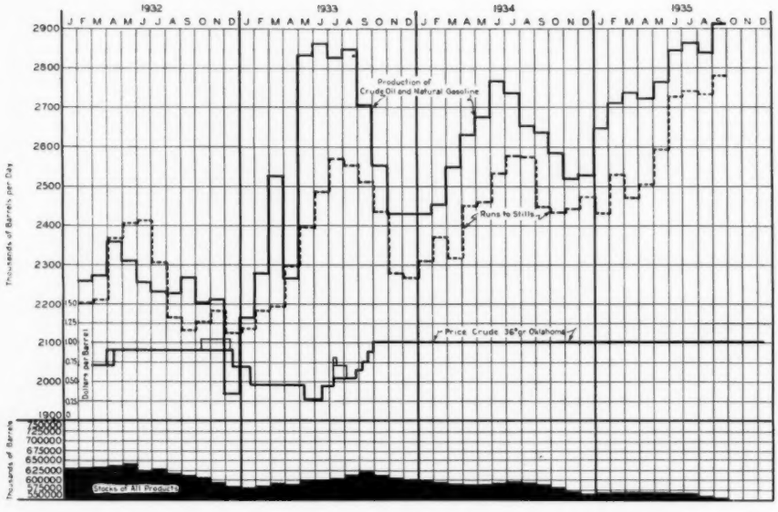
DURING October of 1935, total gross imports of all petroleum products into the United States amounted to 3,809,000 bbl. (123,000 bbl. per day) as compared with 4,747,000 bbl. (158,100 bbl. per day) imported during the preceding month; out of this total during October, 1935, 2,294,000 bbl. (73,900 bbl. per day) were imported for domestic use and 1,515,000 bbl. (48,800 bbl. per day) were imported in transit either for refining and re-export or for use in vessels in foreign trade. During the preceding month, September of 1935, 2,826,000 bbl. (94,100 bbl. per day) were imported for domestic use and 1,921,000 bbl. (64,000 bbl. per day) were imported in bond as indicated above. The crude oil imported for refining and re-export amounted in October, 1935, to 597,000 bbl. During October, 1935, the net imports of 73,900 bbl. per day for domestic use were accordingly 31.8 percent below the former federal recommendation of 108,400 bbl. per day, which was in force under N.R.A.

Exports of all petroleum products during October, 1935, decreased 16.18 percent below the daily rate for the preceding month, amounting to 10,760,000 bbl. (345,000 bbl. per day) as compared with 12,838,000 bbl. (427,500 bbl. per day) which was shipped during September of 1935. While the rate of exports from the United States dropped below the rate of shipments during the last four months, it was considerably in excess of the average exports during the last three years. The October, 1935, total exports were 16.50 percent above the shipments in October of 1934, when 9,236,000 bbl. (298,000 bbl. per day) were exported. For the first ten months of 1935 the total exports of 104,137,000 bbl. exceeded by 9.48 percent the exports during the same period of 1934, when 95,108,000 bbl. were shipped. Exports of crude oil from the United States during October, 1935, however, continued in a diminished volume reaching 4,810,000 bbl. (155,250 bbl. per day) as compared with 4,971,000 bbl. (165,700 bbl. per day) which was shipped during the preceding month and as compared with 3,277,000 bbl. (105,600 bbl. per day) exported in October of 1934. Therefore, in October of 1935, crude oil exports constituted 44.75 percent of the total exports of all petroleum products. During the first ten months of 1935 crude oil exports amounted to 42,991,000 bbl. (141,200 bbl. per day) as compared with 34,010,000 bbl. (112,000 bbl. per day) shipped during the same period of 1934, an increase of 26.4 percent.

During the first nine months of 1935, the gross value of exports of petroleum products amounted to $180,991,958, as compared with the gross value of all petroleum imports of $28,848,430, therefore leaving a large favorable balance of $152,143,528. Gasoline led in the

U. S. production and imports, consumption and exports and price of motor fuel in relation to motor fuel stocks; showing excess daily demand over supply by black areas.


1932
1933
1934
1935
J F M A M J J A S O N D
Thousands of Barrels per Day
Excess Demand Above Supply
Motor Fuel: Domestic Consumption & Export
Motor Fuel: Prod. & Imports
Cents per Gallon
Revised Basis
Thousands of Barrels
Stocks of Natural Gasoline
Stocks of Motor Fuel at Refineries, at Terminals and in Transit



U. S. production, runs to stills and price of crude oil in relation to stocks of all petroleum products.

value of exports in that period of time, being valued at $46,994,027; followed by crude oil valued at $46,010,690; by lubricating oils valued at $45,217,097; by fuel or bunker oil for vessels in foreign trade, not included in domestic exports, valued at $23,027,722; by gas and fuel oil valued at $12,618,214; by kerosene valued at $11,778,633; and by residual fuel oil valued at $6,542,543. The above import figures, however, include imports in bond and if such imports, valued at $9,923,310, were excluded then the net favorable balance for the United States is, in fact, $162,066,838.

Crude Production Continues at Record Levels

CRUDE OIL and natural gasoline production during November of 1935, again established an all-time record by reaching around 3,000,000 bbl. per day, about 35,000 bbl. per day above the crude oil and natural gasoline production during the preceding month, when 2,965,000 bbl. were produced daily, the former all-time record production; this production being 475,000 bbl. per day above crude oil and natural gasoline production in November of 1934, an increase of 18.82 percent. The largest share of this overproduction again was derived from California which exceeded its quota by 5,068,000 bbl., or by 33.40 percent, while Texas overproduced 1,378,000 bbl. and Louisiana overproduced around 1,000,000 bbl. Smaller overproduction was recorded in Oklahoma and Kansas which exceeded their quotas by some 140,000 bbl. and 9,000 bbl., respectively. While the current production is very nearly 300,000 bbl. per day in excess of the recommended estimates of the Bureau of Mines, it is apparent that the federal agency took into consideration neither the continued very high rate of the fall demand nor the high rate of exports. However, current production is fully 150,000 bbl. in excess of desirable production at this time of the year and its continuation at current levels will unavoidably weaken the markets.

Crude oil runs to stills during November, 1935, averaged about 2,780,000 bbl. per day, or about 34,000 bbl. per day above the runs to stills during the preceding month, when 2,746,000 bbl. were refined. Total stocks of all petroleum products declined during October, 1935, by 6,732,000 bbl. to a total of 546,855,000 bbl., indicating a daily gross withdrawal of 217,000 bbl.

October Motor Fuel Demand Unusually Heavy

INDICATED domestic demand for motor fuel during October, 1935, averaged 1,366,000 bbl. per day, a remarkable contra-seasonal increase of 5.86 percent above the daily average during the preceding month, when 1,262,000 bbl. were consumed per day; the domestic demand during October, 1935, was 120,000 bbl. per day above the domestic motor fuel consumption in October of 1934, an increase of 9.86 percent; 262,000 bbl. per day above the domestic motor fuel consumption in October of 1933, an increase of 24.40 percent; and 181,000 bbl. per day above the domestic motor fuel consumption in October of 1931, the peak year before 1934, an increase of 15.67 percent. Therefore, during October, 1935, the domestic motor fuel consumption continued at a higher level for that month than in any preceding year and at a level slightly higher than in July of the current year.

During the past October, 79,000,000 bbl. of motor fuel was exported from the United States, 21 percent below the volume of the preceding month; 24.6 percent above motor fuel exports in October of 1934; but 11.62 percent below motor fuel exports in October of 1933 and 29.2 percent below the motor fuel exports in October of 1931.

On November 1, 1935, motor fuel stocks at refineries, plants, terminals and in transit, inclusive of natural gasoline, amounted to 48,757,000 bbl., an unusual October decline of 2,000,000 bbl. as compared with stocks on hand on October 1, 1935, indicating that during October motor fuel demand exceeded supply by a margin of 64,450 bbl. per day. Motor fuel stocks, as of November 1, 1935, were 710,000 bbl. below stocks on hand on November 1, 1934, when they totaled 49,476,000 bbl.

Business Conditions Continue to Improve

THE New York Times weekly business index advanced rather spectacularly in the last two months, rising from 88.4 in the week ending October 5, 1935, to 95.6 in the week ending November 30, 1935. The New York Times index stood at 78.5 on December 1, 1934; at 74.0 on December 1, 1933; at 69.0 on December 1, 1932; at 77.0 on December 1, 1931; at 87.0 on December 1, 1930; and at 104.0 on December 1, 1929; thus indicating that the present business activity for this season of the year is the highest since the depression started.

The introduction of new models, advanced by the automobile industry from January to November, doubtless stimulated business somewhat, while the vast federal expenditures also exercised a very large favorable influence and the reduction of such expenditures in the coming year may very likely result in the cancellation of the sharp gains of the last two months of 1935.

The encouraging business news of the last few weeks included: the increase of industrial production to around 97 percent of normal, the highest since 1930, affecting a very wide range of industries; a marked increase of residential building; a return of around 250,000 workers to jobs in private industry in October and November each, increasing monthly payrolls by some $8,000,000, with manufacturing employment standing in October at 85.3, the highest since October, 1930, and payroll index standing at 75.1, the highest since March of 1931;

California Crude Oil Prices Since August 29, 1935, Reduction

	Before Aug. 29	Aug. 29	Nov. 1	Dec. 6	Net Change
Long Beach/Signal Hill					
14–14.9 gravity	$0.65	$0.65	$0.75	$0.75	plus $0.10
22–22.9 gravity	0.84	0.55	0.75	0.80	minus 0.04
30–30.9 gravity top	1.09	0.47	0.83	0.96	minus 0.13
Playa Del Rey					
14–14.9 gravity	0.65	0.65	0.75	0.75	plus 0.10
26–26.9 gravity top	1.04	0.36	0.83	0.93	minus 0.11
Elwood Terrace					
37–37.9 gravity top	1.15	0.46	0.89	1.07	minus 0.08
Kettleman Hills					
33–33.9 gravity	0.93	0.62	0.81	0.95	plus 0.02
39–39.9 gravity top	1.11	0.56	0.96	1.11	no change

increases of from 5 to 25 percent above 1934 in retail trade in principal centers of the United States; and the appreciable increase in farming incomes, which for the first ten months of 1935 amounted to $5,563,000,000 as against $5,249,000,000 in the corresponding period of 1934, according to figures released by the Department of Agriculture.

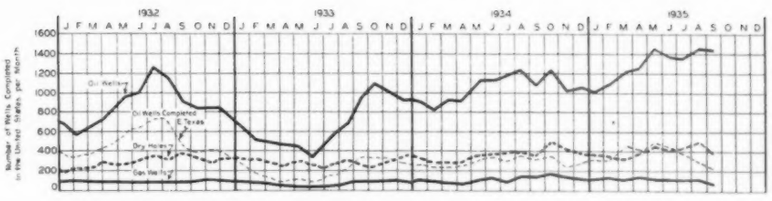
Oil Field Developments in Oklahoma

FITTS pool in Pontotoc County was extended one mile eastward early in December by the completion of J. E. Crosbie, Inc. No. 1-A Burris in section 27–T2N–R7E which was brought in for 859 bbl. per hour through casing from a total depth of 4,160 ft. in the Bromide zone of the Simpson series. While the new extensioner correlates about 100 ft. lower structurally than wells in section 28 it still adds between 750 and 1,000 acres to the Fitts pool which is now increased to about 3,600 acres. Magnolia Petroleum Company (Socony-Vacuum) with 250 acres, Sinclair-Prairie Oil Company (Consolidated) with about 200 acres and Simpson-Fell interests with about 100 acres are the largest lease holders in the new extension. Some 20 new projects have been started around No. 1-A Burris and about 100 wells will be added to the Fitts pool in the near future, bringing the total number of producers to about 350. The current potential production of the Fitts pool is 650,000 bbl. per day from 230 wells. The reservoir pressure in the Fitts field declined from 1,600 lbs to 1,556 lbs during November, with crude oil production from the field reaching 1,000,000 bbl. in that month. In addition to new development 17 Bromide wells were deepened during November to the McLish zone, also in Simpson series, increasing their potential production by 20,743 bbl. per day, or by 1,220 bbl. per well per day.

In the new Jesse pool, Continental Oil Company's No. 1 McCarthy in section 12–T1N–R7E, deepened to 4,633 ft., increased its production 10,000 bbl. per day. Continental Oil Company is by far the largest lease owner near the discovery well holding in excess of 1,000 acres favorably located, and it is also the largest lease owner in T1N–R8E, into which the Jesse folding is apparently extending.

On the Centrahoma structure, the Carter Oil Company's et al No. 1 Thompson in section 34–T2N–R9E was drilling at 6,510 ft. in McLish zone of Simpson series, with formations too tight to show commercial saturation.

The discovery of Jesse field and the extension of the Fitts resulted in the beginning of construction of two new pipe lines. Continental Oil Company is connecting the Jesse area with its Oklahoma City station, a distance of 85 miles, while Stanolind Pipe Line Company is adding an 8-inch line to its present 6-inch line serving the Fitts pool.



U. S. drilling statistics; comparison of oil wells, gas wells and dry holes, with a separate curve showing oil wells in the East Texas field.

Louisiana

RODESSA field in Caddo parish was extended during November one mile west, to within one half mile from the Texas state boundary, and one half mile east, the field now measuring 5½ miles in length and about one mile in width, thus covering 3,400 acres. The Rodessa field was limited on the north by completion of one dry hole and one small well, both in section 10–T23N–R16W, definitely limiting the oil producing zone of the field to one mile in width. Allowing about 20,000 bbl. per acre, the present proven area of Rodessa field indicates a reserve of some 68,000,000 bbl. Current allowable per well is 600 bbl. per day from 24 completions, or about 14,000 bbl. per day from the field. American Liberty Oil Company is drilling an important test in C. M. Robinson survey in Cass County, Texas, about three miles west from present production, while R. W. Norton is certain to extend the field into Texas in his No. 1 W. S. Haywood in Priscilla Evans survey, just across the state boundary, thus confronting the Texas Railroad Commission with a difficult problem of allowable production which is 600 bbl. per day per well on the Louisiana side and 25 bbl. per day per well in the East Texas field.

Eighty miles due southeast from Rodessa field and in Lincoln parish, H. L. Brown No. 1 Monstead in section 10–T17N–R4W was completed for 71,000,000 cu. ft. of saturated gas from 5,301 ft. in the Glen Rose series of the Upper Trinity, the producing formation in the Rodessa field.

In the Louisiana Gulf Coast area Amerada Petroleum Corporation et al No. 1 Weil in section 63–T1S–R2E, in Rapides parish, appeared to be opening a new field when it flowed on a drill-stem test from 5,725 ft. in the Cockfield formation. This discovery made on a prospect surveyed with seismographs by the Independent Exploration Company is possibly located on the general Conroe field trend and will result in extensive geophysical and drilling exploration in an attempt to project the trend through southern Louisiana.

BASIL B. ZAVOICO

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Italian Refinery

ACCORDING to press reports the Italian government has authorized the expenditure of 60,000,000 lira for exploration and drilling in Albania and 70,000,000 lira for the construction of a refinery in Italy. Although the location is not specified this refinery will presumably be located in the industrial zone of Bari as plans for a plant in this location to handle Albanian oil have been in contemplation for some time. In this connection it is reported that the Albanian pipeline is being pushed to completion.

▼

Spanish Shale

IT IS announced that new deposits of bituminous shales, apparently of great extent have been discovered in the Ronda Sierra, province of Malaga, Spain. The discovery was made by Dr. Hernandez Pacheco, professor of Geology at the Central University. This discovery is interesting, in view of the subsidy offered by the Spanish government for manufacture of gasoline from native products.

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OUR FRONT cover picture this month shows oil waste leaving the Port Jerome refinery of the Standard Franco Americaine de Raffinage on its way to a separator where deleterious material is removed.

Effect of Bureau of Mines Recommendations in Principal Oil Producing States

	November 1935				December 1935	Daily Average
	Production bbl.	Percent of Total U.S. Production	Bureau of Mines Quota bbl.	Over-production bbl.	Bureau of Mines Quota bbl.	Product. week ending Dec. 7 bbl.
Texas	32,178,000	37.7	30,800,000	1,378,000	1,005,800	1,070,000
California	20,248,000	23.7	15,180,000	5,068,000	513,800	688,000
Oklahoma	14,920,000	17.5	14,780,000	140,000	480,100	458,500
Louisiana	4,813,000	5.6	3,813,000	1,000,000	128,000	161,000
Kansas	4,291,000	5.0	4,300,000	*	138,700	135,500
United States	85,300,000	100.0	77,000,000	8,300,000	2,540,200	2,805,000

*Kansas underproduced 9,000 bbl. during November.

World Petroleum Abstracts

Summaries of the Most Important Articles as Published in the Oil Press of the World Dealing With Technical and Economic Aspects of the Industry. *Edited by Dr. O. W. Willcox*

Petroleum Geology

Acre-foot Yields of Texas Gulf Coast Oil Fields.—Alexander Deussen, before Petrol. Div., Am. Inst. M. & M. Engineers, Houston, 1935.

The author points out certain errors in published figures on average oil production per acre-foot in several oil fields of the Gulf Coast. It is pointed out that a bed one foot thick and an acre in area contains 7,758 barrels of sand. Sufficient tests have been made of the porosity of various sands from Gulf Coast fields to show that the average porosity of representative sands is not over 25 to 30 percent. If this entire pore space were filled with oil, it would only contain 1,939 and 2,327 barrels of oil, respectively.

To state, therefore, that the acre-foot yield of Spindletop is 7,446 barrels, and of Orange 2,599 barrels, is manifestly an exaggeration, as this would be more oil than could possibly be contained in the sand, and would assume 100 percent recovery.

Outlook for New Oilfields in California.—J. Edmund Eaton, in PETROLEUM WORLD, Annual Review, 1935, pp. 29–34.

The impression prevails that California has been thoroughly prospected, and that while some new discoveries remain for the future the big cycles and fields are a thing of the past.

The author advances two reasons for doubting that California has even nearly reached the point where it can be said to be exhausted of petroleum. One of these reasons is deduced from statistics. When the "relative" new oil discovered in California is plotted by decades, the curve is seen to be a rising one. The fact is that the acreage available for prospecting has increased with the years; geological knowledge is increasing "faster than production methods." In other words, for each new field that is found an area large enough for perhaps two more fields is shown to be favorable. This means that opportunity for new fields is increasing. It is true that no one knows just where these new fields are, but their existence, by the law of averages, is held to be practically certain. The author is strengthened in this conclusion, first by the fact that only half the area of the state has been mapped, and secondly by the fact that the existing maps are continually being found in need of revision, with the result that each new examination turns up additional favorable areas. Some striking examples are given of fields that were formerly dismissed by geologists, but have since been brought to production.

Use of Electrical Logs for Correlation in the Gulf Coast of Texas and Louisiana.—Alexander Deussen and Eugene G. Leonardon, before Am. Petrol. Inst., Los Angeles, Nov. 1935.

The problem of making satisfactory correlations between the formations encountered in neighboring drill holes is particularly difficult in unconsolidated formations. Alternating sands and shales, examined with the naked eye, show such similar characters that it is often impossible to assign to them a definite place in the geological column. These purely *lithological* correlations are difficult to make, and not always reliable. Due to this difficulty, they offer but limited opportunity for the study of underground tectonics.

The purpose of the present paper is to discuss and to illustrate by means of a few examples the use of the Schlumberger electrical logs for the purpose of establishing geological correlation. These surveys are now widely used in the Gulf Coast of Texas and Louisiana for this purpose, and supplement efficaciously the lithological and paleontological conclusions.

The Degree of Reduction and Volability as Indices of Source Beds.—Parker D. Trask and Harold E. Hammar, before Am. Petrol. Inst., Los Angeles, Nov., 1935.

Petroleum is composed of compounds that are highly reduced and rich in volatile matter. It would, therefore, seem as if the organic substances of sediments that generate oil similarly would be characterized by reduced and volatile constituents. Consequently, it is possible that the source sediments, even though they already have generated oil, may still retain some indication of their once having contained relatively large quantities of reduced and volatile organic substances. In order to ascertain the extent to which this hypothesis may be true, the degrees of reduction and volatility of a large number of Cretaceous sediments in several oil-producing and barren areas in Wyoming and Colorado were investigated. The measure of the degree of reduction that was used is the ratio of the organic-carbon content of the sediments to the quantity of chromic acid of given strength that can be reduced by a standard quantity of sediment. The lower this ratio is, the greater is the degree of reduction. The ratio of the nitrogen content to the quantity of chromic acid that is reduced by the sediment was also used to indicate the degree of reduction. The ratio of nitrogen to the reducing power of sediments is determined more readily, and with greater reliability, than the preceding ratio; but it is a less satisfactory index of the degree of reduction, as nitrogen is a less reliable index of the organic content of sediments than carbon. The degree of volatility is measured by the ratio of the assay number to the quantity of chromic acid that is reduced. The larger this ratio is, the greater the degree of volatility. The assay number is a quantitative measure of the tarry material that condenses on the wall of a narrow test tube when a standard quantity of sediment is heated. The work indicates that if high degrees of reduction and volatility are indices of source beds, the relative ranking of the strata as source beds, in descending order, is Thermopolis shale, Mowry shale, Niobrara shale, and shale in the Frontier and Carlile formations.

Drilling

Drilling in Borneo.—M. Naritomi, in OIL WEEKLY, vol. 79 (1935), No. 5, pp. 31–34.

Interesting details are given of wildcat drilling in Borneo, wherein unusual emergencies were encountered and met by appropriate action, including use of gas from the well as a help in drilling the well, and in one instance using the well's gas pressure for recovering a long section of frozen pipe. There are also an interesting description of cementing operations under high gas pressure, and certain novel twists to the theory of drilling muds applied to sidetracking operations and directional drilling.

Evaluation of Rotary-Drilling Lines.—K. N. Saatjian and V. V. Mason, before Am. Petrol. Inst., Los Angeles, Nov., 1935.

This paper is sponsored by the Institute's Committee on the Standardization of Wire Rope and Manila Cordage, in an endeavor to develop a standard method for evaluating wire-rope service. The authors present a formula, including an alignment chart for graphical solution, for determining the work done by drilling lines in terms of ton-miles. Tabular values of drill-pipe weights and similar variables are given, followed by a discussion of safety factors, line speed, loading, methods of attaching rope to drums, drum sizes, lubrication, etc. A chart shows graphically the service due to drill-pipe movements while drilling; another chart provides a method whereby rotary-drilling lines may be retired from service as based on amount of wear and number of broken wires. A table is included showing a summary of operating conditions based upon replies to a questionnaire.

The Anderson T.M. formula is basically sound, and remains intact. However, the value of M in this formula has been increased

to meet recent developments in heavier equipment. A constant has been added to compensate the combined effects of the weights of drill collars and cutting assemblies. A factor based on footage drilled has been provided to compensate for movements of the main string of drill pipe as the result of assembling a stand. A simplified ton-mile chart as developed by H. Schnoor, of the Standard Oil Company of California, has been further revised to conform to changes made in the formula. This form has the added advantage over the present T.M. curves in that it may be readily used for any weight of pipe at any depth, within the limits of the chart.

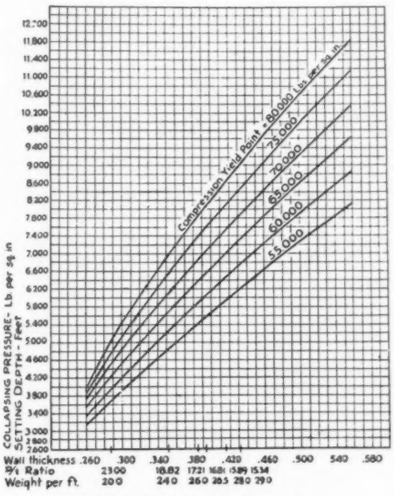
A chart has been provided for retiring rotary-drilling lines which, it is believed, will prove of practical value.

IMPORTANCE OF COMPRESSION YIELD STRENGTH IN ESTABLISHING SETTING DEPTHS FOR CASING.—T. McLean Jasper, before Am. Petrol. Inst., Los Angeles, Calif., 1935.

Higher-compression yield strength in the transverse direction means increased collapse resistance and setting depth of casing. Higher-tension yield strength in the longitudinal direction, coupled with this higher-compression yield strength, means increased "pull-out" strength of threaded and coupled casing. This paper outlines the importance of these higher yield strengths, and describes a new method for obtaining them.

This paper also shows the need for revision of A.P.I. setting depths for casing as published in Supplement No. 1, adopted October 1933.

Correct setting-depth values are indicated


COLLAPSING PRESSURE - Lb per sq in
SETTING DEPTH - Feet
Compression Yield Point - 80000 Lb. per sq in.
75,000
70,000
65,000
60,000
55,000
Wall thickness .260 .300 .340 .380 .420 .460 .500 540 .580
% Ratio 23.00 18.82 17.21 16.81 15.89 15.34
Weight per ft. 20.0 24.0 28.0 32.3 28.0 29.0

6⅝"O.D HIGH YIELD CASING.

in the accompanying figure. This key chart is based on mathematical analysis, and corroborated by some 500 collapse and correlated tests.

RESISTANCE OF MUD THROUGH REGULAR VS. FULL-HOLE TOOL JOINTS.—R. A. March and W. E. Gilbert, before Am. Petrol. Inst., Los Angeles, 1935.

Effects on the fluid-circulating systems of drilling wells produced by substituting full-hole for regular tool joints are discussed. The test data introduced compare use of the two types of joints in drilling strings of the 4½-in. and 5 9/16-in. A.P.I. sizes. Results show that resistances are materially reduced by using full-hole joints. The advantages, either in the form of lower pumping pressures and reduced power costs, or in the form of increased circulation rates, are graphically indicated.

On the basis of data exhibited, it is shown that the maximum rate of flow at 8,000 ft. of depth may be increased about 34 percent in the 4½-in. size and the same percentage in the 5 9/16-in. size by substitution of full-hole joints. Perhaps the most important result of using full-hole tool joints, however, lies in the practicability of increasing the circulating depth range of existing pumping equipment. As shown in Table 2, 10 bbl. per min. can be circulated by one pump, with the bit at 7,680 ft. of depth, using 5 9/16-in. full-hole joints; whereas the maximum depth at which this rate may be maintained using regular tool joints is only 3,680 ft. Similarly, 6 bbl. per min. can be circulated at 7,800 ft. of depth using 4½-in. full-hole joints, while this rate may be maintained only to 5,550 ft. of depth using regular tool joints.

EVALUATION OF ROTARY DRILLING MUDS.—P. H. Jones and E. C. Babson, before Am. Petrol. Inst., Los Angeles, Nov. 1935.

Apparatus used in studying the flow characteristics of muds and the performance of muds when circulated against artificial formations are described. The apparatus used to study flow characteristics is an adaptation of the MacMichael rotary viscosimeter. The results of a number of tests with this instrument are shown and discussed.

The results of tests in the performance testing apparatus show that in most cases neither the pressure differential between the circulating mud and formations nor the apparent viscosity of the mud is of great importance in determining the rate at which mud will lose water to formations or in determining the thickness of mud cakes deposited. Temperature, however, has a marked effect: the higher the temperature, the more rapid will be the loss of water from mud to formations. A single test in the performance testing apparatus will serve to evaluate a mud with sufficient precision to make the results of practical value in selecting and controlling muds for use in difficult drilling projects.

CORROSION FATIGUE OF DRILL PIPE.—F. N. Speller, before Am. Petrol. Inst., Los Angeles, Nov. 1935.

Drill pipe failures that have been recognized as primarily due to corrosion are a relatively rare occurrence compared with failures from other causes; but occasional cases have been found where corrosion, associated with stress, was the controlling factor. These cases require explanation. It has been proved that the so-called "fatigue limit" of metal is materially reduced by even a small amount of localized corrosion; so that if this factor is not brought under control, high-tensile steels that normally have a relatively high-endurance limit may fatigue, under the simultaneous action of corrosion and stress, almost as rapidly as steel with lower tensile strength. The water used in making drilling mud is by itself usually corrosive—especially when aerated; and, therefore, it seemed that the answer to this problem should be found in a study of variations in mud-laden fluids from the standpoint of corrosion.

The present investigation was initiated as a result of the exceptionally short life of 4½-in. grade "D" seamless drill pipe experienced on one of the properties of the Sun Oil Company at Barbers Hill, Tex. This appeared to be due to corrosion fatigue.

The experimental laboratory work referred to in this paper points to mud conditioning as the most promising means of protecting drill pipe against corrosion fatigue.

As a result of this work the author concludes that to avoid corrosion on the outside of drill pipe the metal should be protected from transverse scoring; contact effects and changes of velocity at the joints should be avoided. The alkalinity of the mud should be kept as high as is consistent with a high and stable colloid content. When soluble salts, etc. are encountered that tend to prevent satisfactory mud conditioning, resistance to corrosion fatigue can probably be increased by reducing the free oxygen content with a slight excess of sodium sulphite. Agitation of the mud-fluid stream in contact with air should be avoided as much as possible.

Oil Well Operation

ECONOMICS OF PUMPING.—Bruce H. Robinson, before Am. Petrol. Inst., Los Angeles, Nov., 1935.

Regardless of the sometimes regrettable effect upon ultimate recovery, both the character of proration plans in most fields and the absence of proration in other fields generally require pumping at the maximum practicable rate.

Maximum production rate is secured by:

1. Deep tubing.
2. Adequate pump capacity.
3. Elimination of free gas from the pump.
4. Low casinghead pressure.

Minimum lifting cost is secured by:

1. A suitable pumping machine which must be adequately strong, flexible in speed, and high in efficiency as well as moderate in cost.
2. Below-ground equipment and methods of operation which require a minimum of servicing expense both for number of repairs and cost of individual jobs.
3. Power economy and use of prime movers suitable for the location—first cost, operation, and maintenance costs considered.

INFLUENCE OF WELL DIAMETER ON PRESSURE GRADIENT AND RATE OF OIL FLOW.—L. C. Uren, J. Domercq, Jr., and J. Mejia, in OIL & GAS JOUR., vol. 34 (1935), No. 16, pp. 40–44.

The full title of this paper is "Influence of well diameter upon pressure gradient and rate of flow of oil through the reservoir rock in the vicinity of a high-pressure flowing well."

The intention is to present some preliminary experimental results that will indicate quantitatively the advantages of large diameter wells in comparison with wells of "normal" diameter producing under comparable conditions. For making the investigation the authors used an apparatus that closely reproduces all of the physical conditions existing within the reservoir rock about a high-pressure flowing well. After describing various experiments made with this apparatus, using a California asphaltic-base crude of 24° A.P.I. gravity and a viscosity of 0.03 poise at 65° F.

they present the following conclusions and speculations based thereon:

1. The pressure gradient in the vicinity of a large diameter well is less abrupt than in the vicinity of a small diameter well.

2. Irrespective of the diameter of the well, the pressure gradient is more abrupt in the immediate vicinity of the well when gas accompanies the oil than when gas is absent. The gradient becomes steeper as the differential pressure and gas-oil ratio increase. However, the differences between "live" oil and "dead" oil in these respects are less with large diameter wells than with small.

3. Extrapolation of experimental pressure gradients for 6-inch and 60-inch wells indicates that large diameter wells develop a materially greater drainage radius under a given field pressure than small diameter wells.

4. The rate of production of a 60-inch well producing "dead" oil under a given set of reservoir conditions is nearly 1.5 times that of a 6-inch.

5. The rate of flow of "live" oil under a given pressure differential is greater than for "dead" oil under the same differential pressure.

6. The time necessary for a well to produce a unit volume of oil under a given field pressure diminishes as the diameter of the well is increased.

7. Large diameter wells secure a larger ultimate recovery than small diameter wells under otherwise comparable conditions.

8. Large diameter wells produce with lower gas-oil ratios than small diameter wells.

9. The advantages that go with large diameter wells may be realized practically by forming cavities about them within the oil reservoir rock.

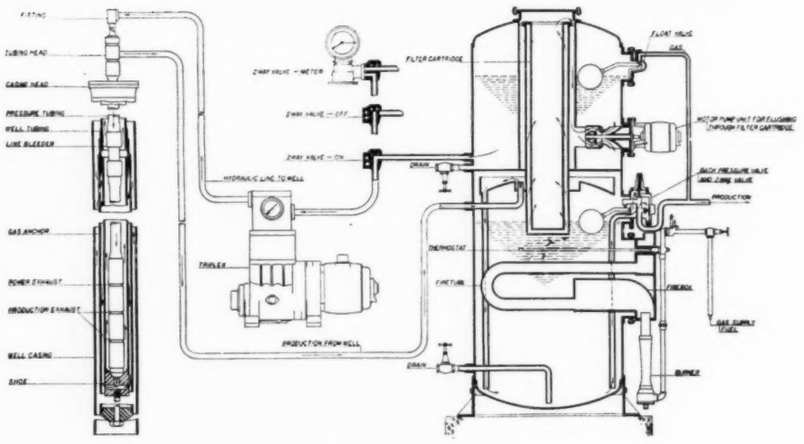
10. The oil reservoir rock in the immediate vicinity of the wall of a producing oil well is a critical zone in which much of the energy utilized in moving the oil through the reservoir rock into the well is consumed.

Bottom Hole Pressure Bombs.—Harold K. Ihrig in OIL & GAS JOUR., vol. 34 (1935), No. 22.

This paper describes the use of a recording type of bottom hole pressure bomb for selecting the proper equipment in large pumping wells. Without such equipment, the operator of a well pumping a large volume of water is handicapped by not knowing the approximate total volume of fluid the well would produce, and hence his selection of equipment to install in the well will be more or less of a hit or miss proposition. This uncertainty can be removed by the use of a bomb for measuring the bottom hole pressure; a record is thereby obtained from which it can be calculated exactly what size pump to install to operate the well at its maximum capacity.

Hydraulic Power Applied to Oil-Well Pumping.—C. J. Coberly, before Am. Petrol. Inst., Los Angeles, Nov., 1935.

Hydraulic power transmission, which has been applied in other industries, is adapted to oil-well pumping. Oil is used as the hydraulic fluid. The equipment includes means for separating gas, water and solids from the operating fluid, and a pump for supplying fluid under high pressure. The subsurface unit is a reciprocating engine direct connected to a double-acting reciprocating pump. The unit is carried by a "macaroni" string of tubing, and inserts within the regular production



tubing. The accompanying flow chart shows the general arrangement of the system.

Many different conditions have been encountered in the preliminary installations of this method of producing oil. Depths of from 2,000–8,000 ft. have been successfully handled. One well has made a considerable amount of sand continuously for nearly four years with very little effect on the equipment, and has reduced pulling jobs from one per month to one every nine months. A number of wells subject to bad paraffin trouble have been successfully pumped with almost complete elimination of wax difficulty, with a considerable reduction in operating cost and a material increase in production. Deep wells with a high water cut have been pumped. One well, too crooked to be pumped by mechanical methods, has been on production for six months with a 100-percent increase in production over gas-lift—at the same time showing large saving in operating cost. One group installation has been made, and has been in operation for 18 months.

A table is given to summarize engineering data and approximate pumping costs for eight wells. While the method has been used in a limited range of conditions, it seems to be adaptable to large or small production, deep or shallow wells and oil of any gravity.

Pipelines

Development of Specifications for Protection of Underground Pipes.—K. H. Logan, in IND. ENG. CHEM., vol. 27 (1935), No. 11, pp. 1354–1357.

Estimates made in 1931 indicate that there were 450,000 miles of pipelines and 27,000,000 house services exposed to soil action at that time. The value of these underground pipe systems was put at $5,000,000,000, and the annual underground corrosion loss was estimated at $142,000,000. There is also a large and growing number of gasoline and fuel oil tanks exposed to soil action.

Since before 1914 the Bureau of Standards has been studying protective coatings for underground pipes. This paper is a summary of the findings in this study given under 18 heads. Points to be regarded in writing specifications are listed as follows:

(1) The coating should resist mechanical shock. The numerical measure of this resistance is not now known, but it can be determined approximately or within limits by tests of coatings known to have this property to a satisfactory degree or by ascertaining the magnitude of the shocks to which pipes are subjected.

(2) The coating should not flow under moderate pressures applied over long periods. The value of this property can also be determined by a study of existing coatings whose performances are known.

(3) The coatings should have and maintain a relatively high electrical resistance. The required resistivity of the coating can be estimated from a study of the electrical data on pipe coatings secured by the American Petroleum Institute, the American Gas Association, and other investigators. This requirement of high electrical resistance, if applied to the coating on the pipe in the trench, will take care of the need for specifying freedom from pinholes, holidays, and abrasions.

(4) The coating should deteriorate but slowly with age and exposure to soil conditions. This requirement probably cannot be embodied in a performance specification but it may be covered in part at least by the exclusion of certain materials known to deteriorate, the presence of which can be detected by tests.

(5) The adhesion between the coating and the pipe should be sufficient to maintain the two in intimate contact when the coating is exposed to such shocks and strains as it will encounter. Otherwise, moisture entering at a point where the coating is ruptured may spread to other sections of the pipe and rusting may follow. Methods for measuring the adhesion of a coating have been developed but no standard has been adopted.

Controlling Paraffin in Gathering Lines.—Frank H. Love, in PETROL. ENGINEER, vol. 7 (1935), No. 11, pp. 33–35.

This paper is a description of a system employed by the Sun Pipe Line Co. to keep its gathering system free from paraffin accumulations; this system is regarded as representative of the best practice in the East Texas Field.

The practice involves the regular use of line scrapers, and the lines are designed especially in view of permitting scraper runs with the

least possible interruption of regular operations, and to permit the work to be handled by a small crew. Headers at all key pumping stations are extended into a concrete pit into which all lines are cleaned; check valves are avoided.

The entire system includes 142.97 miles of pipelines ranging from 10-inch down to 3-inch. The crew consists of a foreman and two helpers who devote all their time to the job (36-hour week). Equipment comprises a 1½-ton truck, an oil pump driven by a 32 h.p. gas engine, and scrapers for each size line, but gravity is used as far as possible. Test runs showed that accumulation of paraffin is directly proportional to the length of the line and the volume of oil handled, so that the work could be standardized on the basis of "annual accumulation per 1,000 bbl. of oil per 1,000 ft. of pipe". It then remained only to lay out a regular schedule which now calls for each line to be cleaned eight times a year. The annual movement of oil is 1,250,000 bbl. and the cost of paraffin removal has figured 0.05 of a cent per bbl., or one percent of the gross gathering expense. Against this direct expense are set the advantages of maximum efficiency due to having clear lines at all times and frequent elimination in small quantities, using static pressure as power. These advantages are considered more than sufficient to offset the direct expense.

Petroleum Refining

ECONOMICS OF ELECTRIC POWER GENERATION COMPARED WITH PURCHASED POWER IN CALIFORNIA REFINERIES.—Roy B. Bryant and Marion E. Dice, before Am. Petrol. Inst., Los Angeles, Nov., 1935.

Installation costs and operating charges have been estimated for a 5,620-kw. Diesel power station and a 5,250-kw. steam-turbine station to serve a California refinery. Continuity of service without recourse to public-utility connections was the first requirement. Two steam proposals were included, identical electrically—one supplying steam for process from extraction turbines, while the other did not.

Local conditions included high water and cooling costs, but a surplus of non-commercial grades of fuel. Costs were compared with purchased power over a wide range of power rates, fuel costs, and monthly power consumption.

Final comparisons were made by charts which took any set of conditions for the given plant, and solved directly for the time in years required for the savings to repay the investment with interest.

Steam turbines appear more economical than Diesel engines under the conditions involved. It was concluded at the outset that motors are more economical for most individual refinery drives than non-condensing steam turbines.

At present fuel costs and power rates in California, none of the three proposals was found attractive at 30-percent plant-load factor; all were attractive at 60-percent, or better. High plant-load factors, involving a minimum of excess capacity to guarantee service during peak demands, are most difficult to attain when such guarantee is essential.

A jointly-owned steam plant supplied with cheap fuel from the refinery, operated by a utility and inter-connected with its system, is mentioned as a possible way to decrease power costs.

ECONOMIC AND TECHNICAL ASPECTS OF POLYMERIZATION.—E. Ospina-Racines, in WORLD PETROLEUM, vol. 6 (1935), No. 10, pp. 616–622.

Polymerization processes for the conversion of hydrocarbon gases into liquid motor fuels are now in active development. There are several types of such processes which may be categorized as follows:

1—High-pressure polymerization at pressure ranges of 200–2,000 lbs. per square inch and temperatures from 800° to 1,000° F.

2—Low-pressure polymerization at pressure ranges of 50–200 lbs. per square inch and temperature ranges of 950° to 1,500° F.

3—Catalytic-polymerization under pressures of 150–200 lbs. per square inch and temperatures around 450° to 500° F.

The principal raw materials for these polymerization processes are cracking-still gases; in fact, it was the interest in converting these low-value by-products that is mainly responsible for the new development. The value of these gases for the purpose is in proportion to their content of olefines and other unsaturates; they can be subjected to polymerization without pretreatment, whereas the saturated hydrocarbons of natural gas must first be cracked to fit them for the process, although the great abundance and low cost of natural gas may make it practicable to use this material. Yields range from 3 to 12 gallons of fuel per 1,000 cu. ft. of gas. An outstanding property of the product is its high-octane blending value. One of the principal advantages of polymerization, therefore, is that it gives a means of conferring higher values on low octane or straight run gasoline, thus improving the general quality of the refinery output. The author discusses the technical and financial aspects of polymerization at considerable length.

INSPECTION OF HIGH PRESSURE EQUIPMENT.—Franklin L. Newcomb, before 24th National Safety Congress, Houston, 1935.

In this address a supervising engineer of the Standard Oil Development Company tells what he has learned from high pressure equipment inspection. His experience has evidently been rich and varied. Out of this experience have emerged certain universal principles that should govern all inspectors. One is that insections should be made with a frequency depending on the character of the contents, pressure, temperature, material used in construction, known safety factors and the protection that has been provided against corrosion.

Another important point is that inspections shall be complete. Pressure vessels containing petroleum products and gases seldom operate as isolated pieces of equipment. They are usually part of a complex group of equipment interconnected with piping. Different pressures may prevail in various parts of the equipment and different vessels constituting part of the same equipment may be designed for and operate under different pressures. Various pressures in different parts of the equipment may be maintained by automatic devices or by hand-throttling. Temperature may also vary considerably throughout a unit and may be controlled either manually or automatically. Both temperature and pressure may be varied from time to time, depending on the stock being processed or the products being made. Owing to the interconnection of a number of vessels in one system by piping and dependence on valves for controlling pressure in the various parts, it is not feasible to divorce the inspection of vessels from the other parts of the equipment. Failure of piping may discharge the entire contents of a vessel or an entire system onto the ground. It follows that the entire unit must be subjected to the same careful inspection.

The careful inspector will always take the attitude that he may find corrosion *anywhere*. A rivet head may be seriously corroded and yet show little sign thereof. And the inspector must forever be suspicious of all safety valves.

OCTANE NUMBER IMPROVEMENT IN NAPHTHA REFORMING.—S. D. Turner and E. J. LePoi, in IND. ENG. CHEM., vol. 27 (1935), No. 11, pp. 1347–1349.

A correlation of plant cracking data is effected that satisfactorily gives the octane number obtainable in reforming naphtha in terms of the original octane of the charge and the amount of cracking to which it is subjected. The amount of cracking is expressed in terms of equivalent seconds at 900° F. which are derivable from, or convertible to, an actual time-temperature curve on the assumption that the cracking rate doubles with a rise in temperature of 25° F.

By mathematical treatment the octane improvement of naphtha can be predicted. For purposes of still design, the method may be worked backwards.

Petroleum Chemistry

POLYMERIZATION OF ETHYLENE.—V. N. Ipatieff and Herman Pines, in IND. ENG. CHEM., vol. 27 (1935), No. 11, pp. 1364–1369.

The polymerization of ethylene under high pressures in the presence of 90 percent phosphoric acid was studied for the first time. Catalytic polymerization of ethylene yields a mixture of paraffinic, olefinic, naphthenic, and aromatic hydrocarbons. Thermal polymerization of ethylene under similar conditions does not yield aromatic hydrocarbons. The high-pressure catalytic polymerization of ethylene yields isobutane, the percentage of which increases with the temperature of polymerization. From 250° to 330° C. it varies from 2.5 to 18.8 percent by weight of the ethylene which reacted.

Analysis of the gases at different temperatures permits us to assume that cracking does not take place to any appreciable extent. A mechanism of ethylene polymerization is suggested.

PROCEDURE FOR CLASSIFICATION OF HYDROCARBONS.—Samuel P. Mulliken and Reginald L. Wakeman, in IND. ENG. CHEM., analyt. ed., vol. 7 (1935), No. 4, pp. 275–278.

A method is described for qualitatively classifying hydrocarbons according to their structures. The system used divides the liquid hydrocarbons into three groups, depend-

ing on their densities and reactivities with bromine, nitric and sulphuric acids. By means of density the aromatics and other heavy hydrocarbons are classified apart from the acyclics and the lighter cyclics, which are divided into two groups on the basis of their behaviors with the reagents named.

By means of the described procedure the hydrocarbons are subdivided into a large number of sections, making it possible to classify a hydrocarbon of unknown structure experimentally and quickly.

Present Status of the Isolation and Identification of Volatile Hydrocarbons in a Mid-Continent Petroleum.—Robert T. Leslie and Joseph D. White, in BUREAU STANDARDS JOUR. RESEARCH, vol. 15 (1935), No. 3, pp. 211–225.

The work to date of the American Petroleum Institute's Research Project 6 on the fraction of a midcontinent petroleum boiling normally between 55° and 180° C is summarized. In the fraction, 55° to 145°, estimates have been made of the percentage contents of the 22 hydrocarbons actually isolated, the 6 hydrocarbons detected and in process of separation, and the 19 hydrocarbons whose presence in significant amounts is suspected. These quantities have been represented graphically in relation to the curves, showing the distribution with temperature of the volume and the refractive index of the distillate.

It is probable that the foregoing 47 hydrocarbons will account for practically all of the material in this fraction. On this assumption, the relative amounts of paraffin, naphthene, and aromatic hydrocarbons in the fraction are estimated to stand in the ratio of 6:3:1.

In the course of separating the individual hydrocarbons, it has been necessary to develop methods which may be utilized on a larger scale for the production of these chemical individuals from petroleum. The analysis has resulted in information which makes it possible to predict the occurrence in similar crude oils of individual hydrocarbons whose presence accounts for the properties of the commercial products of petroleum.

The hydrocarbons isolated are listed in the accompanying table.

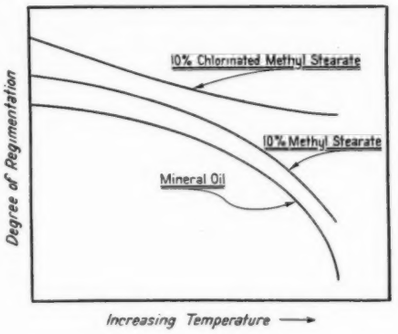
Formula	Hydrocarbon	Estimated amount in crude[1]	Purity of best sample[1,2]
		Percent	*Mole percent*
	PARAFFINIC		
CH_4	Methane	a	a
C_2H_6	Ethane	a	a
C_3H_8	Propane	a	a
C_4H_{10}	*n*-Butane	a	a
C_5H_{12}	*n*-Pentane	a	a
C_5H_{12}	2-Methylbutane	a	a
C_6H_{14}	*n*-Hexane	0.5	98.3
C_6H_{14}	2, 3-Dimethylbutane	....	95
C_6H_{14}	2-Methylpentane	.3	95
C_6H_{14}	3-Methylpentane	....	95
C_7H_{16}	*n*-Heptane	.9	99.9
C_7H_{16}	2, 2-Dimethylpentane	.03	54
C_7H_{16}	2-Methylhexane	.25	99.9
C_7H_{16}	3-Methylhexane	b	b
C_8H_{18}	*n*-Octane	1.0	99.1
C_8H_{18}	2-Methylheptane	.15	97
C_9H_{20}	*n*-Nonane	1.0	99.9
C_9H_{20}	2-Methyloctane	b	b
C_9H_{20}	2, 5-Dimethylheptane	b	b
$C_{10}H_{22}$	*n*-Decane	.8	99.9
	NAPHTHENIC		
C_5H_{10}	Cyclopentane	a	a
C_6H_{12}	Methylcyclopentane	0.2	98.9
C_6H_{12}	Cyclohexane	.3	99.9
C_7H_{14}	Methylcyclohexane	.3	99.9
C_7H_{14}	1, 1-Dimethylcyclopentane	.04	95
C_8H_{16}	1, 3-Dimethylcyclohexane	.15	98
C_8H_{16}	Ethylcyclohexane	.1	95
C_9H_{20}	Nonanaphthene	.1	99
	AROMATIC		
C_6H_6	Benzene	0.08	99.8
C_7H_8	Toluene	.3	a
C_8H_{10}	*p*-Xylene	.04	99.9
C_8H_{10}	*o*-Xylene	.12	99
C_8H_{10}	*m*-Xylene	.12	99.9
C_8H_{10}	Ethylbenzene	.03	94
C_9H_{12}	Hemimellitene	.06	99.9
C_9H_{12}	Pseudocumene (trimethylbenzenes)	.02	99.9
C_9H_{12}	Mesitylene		

[1] a, not determined; b, determination in progress.
[2] Values calculated from freezing-point data.

Petroleum Physics

Fundamental Chemical and Physical Forces in Lubrication, I.—G. L. Clark, B. H. Lincoln and R. R. Sterrett, before Am. Petrol. Inst., Los Angeles, Nov., 1935.

This paper considers the nature of the forces emanating from metal surfaces and from various types of molecules found in and added to lubricants. X-ray diffraction methods are used to study the orientation of polar molecules on metal surfaces, the thickness of such films, the regimentation of polar molecules in lubricating-oil solutions, and the protection of metal surfaces from wear by such adsorbed oriented polar molecules. The work of the authors confirms conclusions from the literature that the extent of the fields of force between metal surfaces and polar lubricants is many times greater than mono-molecular dimensions and approaches, if it does not exceed, the distances between surfaces in viscous lubrication. Highly-polar molecules, such as the esters of chlorinated aliphatic acids and monohydric alcohols, have a powerful effect on the formation of adsorbed films in boundary lubrication and the molecular regimentation in viscous lubrication.



By "regimentation of polar molecules" is meant that the molecules of highly-polar substances added to mineral lubricating oils form a compact film on the bearing metals, thus helping to keep them apart. The relative effectiveness of such additions is illustrated by the accompanying diagram, which compares the "regimentation" of mineral oil molecules in lubricants with those of added methyl stearate and chlorinated methyl stearate.

Energy Relations in a Flowing Well.—B. H. Sage and W. N. Lacey, before Am. Petroi. Inst., Los Angeles, Nov., 1935.

In any attack upon the problems presented by the flow of fluids through pipes or porous media, a knowledge of the properties of the fluids involved is a primary requisite. In the case of fluids whose properties undergo large changes during the flowing process, these properties must be known over the ranges of conditions which may be encountered in practice.

The properties whose values must be measured for this purpose will depend upon the method of attack upon the problem. One method which offers some promise in dealing with the complicated case of the flow of complex mixtures of naturally-occurring hydrocarbons involves the use of those fundamental energy relations which are dealt with in thermodynamics. Properties which appear to be most useful in this connection are specific

volume, heat content, and entropy; and they must be known as functions of temperature and pressure throughout the range of conditions likely to be met in field practice. These three properties are well known to engineers dealing with steam-power equipment, compressors, and refrigeration machinery.

As a subject for experiment the authors took a well 5,170 feet deep. Diagrams are given showing volume relations, formation volume, solubility curves, specific heats at constant volume, temperature-entropy, results of field measurements of distribution of pressures and temperatures, average velocity of flow at different depths, heat lost to surroundings and energy involved in friction. The use of such data is pointed out. The work was carried out as a part of A. P. I. project 37 on hydrocarbon behavior.

Use of Petroleum

Graphitizing Lubricating Oil.—C. Stephan, in OEL UND KOHLE, vol. 11 (1935), No. 36, pp. 665–668.

Although the use of graphite as an addition to lubricating oil has long been known, it is not yet sufficiently appreciated by machinery operators. The preparation of graphite for this purpose took a long step forward when, in 1906, Acheson introduced his "Oildag", composed of 10 percent colloidal graphite and 90 percent oil. Since then improvements have been made, and it is now possible to use graphitized oil with highly developed and intricate machinery. A lubricating graphite should contain no particles larger than 5 *mu*. Only a small proportion, 0.03 to one percent, is needed for giving a very good lubricating effect.

The use of graphite makes it possible to employ oils of low viscosity (but of otherwise good character) for lubricating purposes. Graphite also makes it possible to construct bearing surfaces of what have heretofore been regarded as inferior metals. These are two important considerations in a country situated as Germany now is.

Some Characteristics of Internal Combustion Engines When Operating with Butane-Air Mixtures.—C. J. Vogt, before Am. Petrol. Inst., Los Angeles Meeting, 1935.

A thorough understanding of the relation of the independent variables to the operating characteristics of internal-combustion engines is required if the most economical utilization of the fuel is desired. Most exacting data are essential if the variables are to be separated. The Department of Mechanical Engineering at the University of California has planned an engine-test program which it is hoped will, when complete, answer many questions relative to the relation between the independent and dependent variables in internal-combustion engines.

The results so far obtained indicate: 1, that the friction horsepower increases at a decreasing rate as the compression ratio is increased, and that with the use of a light crankcase oil partial lubrication is evidenced; and, 2, that the volumetric efficiency, to which the torque developed is proportional, decreases with increased compression ratio, spark advance, fuel-air-mixture ratios approaching those for complete combustion, and is a function of valve timing.

Butane as a motor fuel shows many advantages over liquid fuels. The homogeneous mixture obtainable with a gaseous fuel increases the economy in multi-cylinder engines through the more uniform mixture distribution to the individual cylinders, particularly when the engine is operating relatively cold at normal atmospheric temperatures. For most economical utilization of the fuel, it is important to adjust accurately the carburetor and spark settings, in order that maximum economy at the part-throttle settings for average operation may be obtained.

Improved Lubricants and Lubrication, II.—L. L. Davis, Bert H. Lincoln and B. E. Sibley, before Am. Petrol. Inst., Los Angeles, Nov., 1935.

This paper outlines the points which must be observed in the practical selection of improved lubricants, by which is meant mostly mineral oil lubricants to which certain additions have been made. The preferred additions are small percentages of an ester of a chlorinated aliphatic acid and a monohydric alcohol such as methyl alpha-alpha-dichlorostearate. In reaching their conclusions the authors have made a large number of careful tests with oils and bearings. The various factors that have been studied are defined as follows:

1. *Load-carrying capacity:* The ability to carry the highest possible load at the highest probable temperature with a minimum supply of oil for an indefinite period.
2. *Oiliness:* The ability of a lubricant to operate under boundary or thin-film conditions with low friction and resultant low heat formation.
3. *Metal wear:* The oil must not only carry high loads with low friction, but must do so without appreciable metal wear.
4. *Corrosiveness:* Neither the agent nor its decomposition products should be corrosive to any metal with which it will come in contact during distribution or service.
5. *Corrosion protection:* The product must not only be non-corrosive itself, but should form a strongly adsorbed film on metal surfaces which will protect them from the corrosive products of combustion and of oxidation of the mineral oil.
6. *Stability:* The addition agent must not only be stable under the highest temperatures reached, but it must not accelerate the oxidation of the mineral oil. It should act preferably as an inhibitor.
7. *Physical characteristics:* Its physical characteristics, such as volatility, flash point, pour test, solubility, etc., must not be detrimental to the required specifications of the mineral oil.
8. *Toxicity:* The addition agent must have neither toxic nor obnoxious characteristics.

Rating Aviation Fuels in Full-Scale Aircraft Engines.—C. B. Veal, before Am. Petrol. Inst., Los Angeles, Nov., 1935.

This is a report of the A.P.I. Cooperative Fuel Research Committee formed in 1931 to consider data on detonation in multi-cylinder aircraft engines, and in pursuance of this object a test program was drawn up and carried out.

The principal purpose of this series of tests was to ascertain whether octane-number determinations made by the C.F.R. motor method (ASTM designation D 357–34T) of rating motor fuels correlate satisfactorily with the behavior of aviation fuels of widely different types in representative full-scale aircraft engines; and, if necessary, to develop a method for the knock rating of aviation gasolines which will be applicable specifically to all varieties of fuels and to all types of spark-ignition aircraft engines.

The program provided for the investigation of three series of fuels:

"a" Those whose knock characteristics are essentially unchanged under varying test conditions.

"b" Those whose knock rating decreases sharply with increasing severity of test conditions.

"c" Those whose knock rating improves with increasing severity of test conditions.

The tests herein described show satisfactory correlation (up to 87 octane number) between "motor method" laboratory ratings for fuels "a" and "a" plus lead and "b" and "b" plus lead, but indicate that in this range fuels "a" plus benzol and "c" plus lead are somewhat over-rated by the present laboratory test, and that the performance of a particular benzol blend may vary within rather wide limits—depending on engine design and operating conditions. In view of these results and the need of considering fuels in the range above 87 octane number, no attempt will be made to secure improved correlation by modifying the "motor method" until further experimental data are available.

Synthetic Fatty Acids.—Anon., in CHEM. ZTG., vol. 59 (1935), No. 84, p. 857.

Reference is made to the work of the Russians Petrov and Varmalov of the Mendeleeff Institute on the preparation of synthetic fatty acids from petroleum. Russia, like Germany, is laboring under a shortage of animal fats. The work has now progressed to a stage where blowing air at atmospheric pressure through paraffin at 160°–170° C. results in a yield of up to 50 percent of fatty acids. However, the product always contains 10–12 percent of oxyacids, which have little value for soap making purposes. Attempts to avoid the production of these acids by preparing and saponifying sulphonated mineral oils have not yielded better results. Difficulty has been encountered in separating the oxyacids from the other products. Efforts are now being directed toward transforming the oxyacids into unsaturated acids.

Asphalt and Tar

Separation of Petroleum Asphalts by Fractional Solution.—A. Zwergal in OEL UND KOHLE, vol. 11 (1935), No. 35, pp. 608–609.

According to the author, petroleum residues are systematically extracted, first with methyl alcohol and then successively with ethyl, propyl, butyl and amyl alcohols. The first named alcohol extracts principally the petroleum hydrocarbons, the second principally the petroleum resins, the third the asphalt resins, the fourth the hard asphalts, the fifth the carbenes, while the carboids remain as the insoluble residue. Colombian, Iranian, Nienhagen and Roumanian distillation residues,

Percentages of Different Extracts Obtained from Distillation Residues

Solvent	Colombian	Iranian	Nienhagen	Roumanian
Methyl alcohol	3.9	8.7	2.6	8.6
Ethyl alcohol	10.1	6.5	3.7	14.4
Propyl alcohol	42.8	66.6	92.1	58.7
Butyl alcohol	36.2	7.6	1.6	9.7
Amyl alcohol	3.2	4.9	..	2.3
Residue	3.8	5.4	..	6.3

when subjected to this treatment yielded the percentages of the different extracts indicated in the accompanying table.

The third fraction in all cases is the one present in the largest quantity; as shown by elementary analyses made as a part of this investigation, this fraction has the largest carbon and hydrogen content and the lowest content of sulphur and oxygen. The fourth to the sixth fractions are coke-like products, while the first and second fractions are oily and resinous. The elementary analyses also indicate that in the third to sixth fractions inclusive, polymerization becomes increasingly pronounced.

IMPORTANCE OF HEAT CONDUCTIVITY OF BITUMEN.—Edmund Graefe, in PETROLEUM, vol. 31 (1935), No. 40, pp. 1–4.

Of late more attention is being paid to the heat conductivity of tars, bitumens and asphalts. The heat conductivity of bitumen is in general small; this may be a desirable property where heat is to be kept in, but undesirable where heat should be thrown off. In the case of electric insulation applied to wires that are liable to become heated by passage of the current, retention of this heat by the covering compels the use of wires of larger diameter than necessary. Hence it is desirable to mix the bitumen with a filler that of itself is a poor conductor of electricity, but a relatively good conductor of heat. According to recent experience the best material for the purpose is quartz sand in a granulation between 0.1 and 0.4 millimeter; amorphous (sintered) quartz is much less suitable; still less suitable from the standpoint of heat conductivity are powdered glass, porcelain and mica. In fact, of all the non-metallic organic and inorganic materials used as electrical insulators, crystalline quartz has the highest heat conductivity. The quartz-bitumen mass for electrical insulating purposes may contain as much as 75 percent of quartz sand without serious demixing. The compounding process must be so conducted that the bitumen will have a polar character, and thus more easily envelope the quartz grains that have been made pyroelectric by heat. The dielectric resistance of such mixtures is good, and the mixture may be made unburnable by addition of diphenylchloride. The new quartz-bitumen insulating mass makes it possible to prevent the heating up of electrical apparatus, and thus save both copper and space. Even large transformers have been built with this filling; its advantage over oil for this purpose is stated to be in the smaller coefficient of expansion and the smaller tendency to age. It is considered preferable that the bitumen producers prepare the mixture rather than leave it to special firms or the user himself.

On the other hand, good heat conductivity is less to be desired in tar or asphalt pavements, for the reason that such pavements are more likely to acquire a thin coating of ice in foggy weather following a period of dry cold. Hence road tars for streets, sidewalks and steps should be mixed with the poorest heat conductors obtainable.

Petroleum Reserves

ROCKY MOUNTAIN CRUDE OIL RESERVES.—W. W. Boyer, in OIL WEEKLY, vol. 79 (1935), No. 8, pp. 24–29.

This article summarizes what is known of the future crude oil reserves of the Rocky Mountain district, which includes the States of Wyoming, Northeastern Arizona, Utah, Idaho, Montana and New Mexico. It is shown that the region has a proved supply sufficient for its own needs for the next 30 years. The prospects for future development in the region are not exceedingly bright, with deeper drilling offering the best chances for success.

SOUTH TEXAS RESERVES.—Earl S. Post, in OIL WEEKLY, vol. 79 (1935), No. 11, pp. 21–50 (with map).

In the Texas region south of the Balcones fault line are 164 producing oil fields, covering some 60 counties, grouped in eleven districts. The total production to January, 1935, has been 255,401,991 bbl. The expected recovery of proven acreage is 591,794,404 bbl., and recoverable crude still in the ground is estimated at 336,392,413 bbl. However, the picture in South Texas is rapidly changing and the region is still too young to admit of a projection of its ultimate importance. Some geologists assert that the region will produce oil and gas as deep as the bit can penetrate, and it is likely that wells 15,000 to 20,000 feet deep will be put down when equipment is designed to explore to such levels.

LAWS OF PRODUCTION DECLINE OF AN OIL WELL.—W. Tiraspolsky, in REV. PETROLIFERE, No. 652 (1935), p. 1316.

Among the numerous formulae that have been proposed for representing the decline of production of an oil well, there is one which, according to the author, deserves to take first place because of its simplicity and the ease of its application. This is the law of exponential decrease, which differs only in form from the law of decrease by constant percentage and the law of cumulative linear decline.

If p_o is the initial production of a well, p production after a lapse of time, t may be expressed by an equation in the form of

$$p = p_o\, e^{-\frac{1}{K}t}$$

wherein e is the logarithmic base and K is a coefficient that is characteristic of the well under observation.

This law has been verified in a large number of cases. In essence it is the law of the emptying of a reservoir filled with a compressible fluid that is being expelled by a releasing force, and is similar to the law of drainage of a viscous liquid that is running out under the force of gravity.

By representing this decline law in a nomogram, various production problems encountered in practice may be quickly solved. The characteristic coefficients are deduced from the production curve of the well.

ESTIMATING RESERVES FROM RESERVOIR ENERGY AND OIL PRODUCTION DATA.—Ralph J. Schilthaus, before Petrol. Div., Am. Inst. M. & M. Engineers, Houston, 1935.

The purpose of this paper is first, to present the derivation of a modified form of the equation given by Coleman, Wilde and Moore, which will permit the calculation of what is defined as the "active oil" content of a reservoir; second, to derive formulae for calculating the reservoir energy changes that occur during the course of production, and finally, to discuss the limitations and application of the equations developed.

It is believed that where sufficient and proper data on production, reservoir pressure behavior, and the properties of the oil and gas are at hand, the approximate quantity of oil contained in the interconnected and permeable parts of the reservoir can be calculated from the formulae here developed.

Petroleum Substitutes

FUELS FOR AUTOMOTIVE GASOGENES.—Ch. Berthelot, in ACTUALITE CHIM. IND., vol. 34 (1935), No. 4, pp. 759–762.

This study indicates the conditions to be fulfilled if the automotive gasogene is to enter current practice. These conditions are: the apparatus must be light, able to use fuel of small sizes, capable of starting instantaneously or at least in three minutes, furnish the same quality of gas at all speeds and have a large radius of travel; it must not subject the motor to excessive deterioration and must be capable of adaptation without difficulty or excessive cost to all the principal types of chassis. There are now available types of gasogenes that meet these conditions in a satisfactory manner and thorough road tests have demonstrated their practicability and economy. The economy is large, especially in view of the fact that in such countries as France, Germany and Italy, automotive vehicles equipped with gasogenes are exempt from all taxes and in some cases enjoy a subsidy. The choice of fuel depends on local circumstances; anthracite, semicoking coals, or wood charcoal serve equally well.

FUTURE OF BITUMINOUS COAL HYDROGENATION.—Oskar Tokayer, in PETROL. PRESS SERVICE, vol. 2 (1935), No. 21, pp. 4–5.

Referring to the recent opening of the coal hydrogenation plant at Billingham, in England, it is observed that while the main technical problems of coal hydrogenation have been solved, it is quite clear that the same does not apply to the commercial problems connected with this new industry. It is possible to produce synthetic gasoline from bituminous coal, but only at a cost which everybody admits is very much higher than that of gasoline refined from crude petroleum. Its production, therefore, is commercially possible

only by concessions in respect to taxes and duties which in reality amount to large subsidies. When it is pointed out that the existing duty exemptions granted to home-produced gasoline in Great Britain are equivalent to about 200 percent of the c.i.f. cost of imported gasoline at any port in Great Britain, and that the corresponding exemption in Germany is equivalent to over 300 percent of the cost of imported gasoline c.i.f. Hamburg, it is obvious that the subsidies which are required to make the synthetic production of hydrocarbon oils from indigenous material profitable go far beyond the extent of the protection which could be asked for with any hope of success by any ordinary industry.

The case for such subsidies must obviously be based on pleading of a special character. In Germany, the extraordinary encouragement which the Government is giving to the greatest possible development of gasoline production from indigenous materials is founded almost entirely on political and strategic considerations. In England, however, the supporters of the policy point to the additional employment which they claim will be provided in the coal-mining industry. But the Billingham plant, even when working at full capacity, will supply less than four percent of oil consumed in Great Britain, and will absorb much less than one percent of the annual coal output.

Petroleum Economics

The Corrosive Effect of Taxation.—Baird H. Markham, before Am. Petrol. Inst., Los Angeles, Nov., 1935.

High taxes are particularly objectionable to petroleum marketers because the public reduces its consumption and the activities of tax evaders undermine the price structure. The general result is that the producers have to absorb the tax. The fact that the average annual earnings of the petroleum industry during the past ten years have been less than 2 percent (in 1934 less than 3 percent) is ascribed to this "corrosive" effect of taxes.

Under these circumstances the industry should "dramatize" the tax to the public and thus create a force to resist the flood of tax bills; there are now 201 different types of taxes levied on the petroleum industry and its products. One-fourth of the nation's population visits the filling stations weekly, and it is recommended that the industry cause every service station attendant to say, "That's one dollar for the gasoline and 50 cents for tax. The tax is high, isn't it?" If this formula is sufficiently reiterated the public will become sales-tax-conscious, and this feeling may be expected to have some effect in repressing the avidity of the tax gatherers.

Automotive Diesel Costs.—C. G. Anthony, before Am. Petrol. Inst., Los Angeles Meeting, 1935.

This paper develops, from actual cost figures, the relative costs of operating Diesel-powered, heavy-trucking equipment, as compared with like equipment which depends upon gasoline motors for power.

The conclusions show that the economy of a Diesel-powered motor truck, at its present stage of development, is the result of its low fuel consumption, from the standpoint of gallonage, and the relative cheapness of fuel used, when compared with the greater quantity and more expensive fuel used by a gasoline-motored unit.

With the exception of this lowered operating cost for fuel, all other costs incurred in operating Diesel-powered trucks are either equal to or greater than the costs for similar material or services used in gasoline-powered vehicles.

Due to the fact that this saving in fuel cost is so large, the paper shows that the cost of operation of heavy-trucking equipment can be reduced very substantially when Diesel engines are used for power in place of gasoline motors.

The actual figures obtained from a study of a large number of Diesel-powered trucks in comparison with a large number of gasoline-powered trucks show that the cost differential in favor of Diesel power is $0.02527 per mile. This takes account of all items, including depreciation, interest and insurance.

The Petroleum Refiner Views the Development of High-Speed Diesel-Engine Fuels.—William Mendius, W. Ainslee and C. H. Schlesman, before Am. Petrol. Inst., Los Angeles meeting, 1935.

The conventional Diesel engine, which has been in use for one-third of a century, has demonstrated its ability to operate upon fuels of almost every description. The modern high-speed Diesel, however, requires a carefully prepared fuel for its successful operation.

At the present time the great variety of fuel specifications in vogue threatens to limit the widespread adoption of high-speed Diesels. In the present paper the authors point out that the costs of distribution of Diesel fuel will become excessive unless the Diesel builders and the consumer are able to agree upon a smaller number of grades.

It is suggested that advantage be taken of the existing distribution systems which have been set up for the distribution of household-burner fuels. If cooperation between the engine builder and the refiner is possible, the authors believe that household-burner fuels can be developed which will also be satisfactory for use in modern high-speed Diesel engines.

General

Progress Report of Automotive Survey Committee.—A. Ludlow Clayden, before Am. Petrol. Inst., Los Angeles, 1935.

This committee was created a year ago to study changes in automotive design from the viewpoint of possible or probable effect on petroleum products.

In this first progress report the Committee emphasizes the fact that the automobile manufacturer is most interested in the sale of new cars, whereas the oil industry has to consider not only the owners of new cars, but also the much larger number of owners of old cars. Since 1933 the new cars have required gasoline with octane rating not much less than 70, but at the end of 1934 not more than 15 percent of the cars on the road required more than 65 octane, and at the end of 1935 the proportion will probably be not more than 30 percent. The effect has been to put the oil industry to enormous expense to satisfy a small proportion of gasoline users. This is cited as an instance of how changes in automobile design have pushed the petroleum industry. The point is that the automotive engineers may overdo the matter; if they go on raising compressions and demand higher octane they will find that the gasoline producer cannot go further without raising the cost of motor fuel.

The fact is that in their eagerness to promote obsolescence, the automobile manufacturers are forcing the oil manufacturers to undertake improvements and assume costs that are not required by the bulk of their trade. There should be a better balancing between the interests of the two associated industries. There should be organized testing of automobiles. The laboratories of the oil companies are the places where new cars should be tested for their petroleum-product requirements. Instead of using cars to test products, products should be used to test cars.

Note.—This report contains much interesting and clearly presented information; it is well worth reading.—Ed.

Cost of Producing Crude Petroleum.—Announcement by Petroleum Administration Board, November 21, 1935.

A preliminary statement on the cost of producing crude petroleum in this country has been issued by Secretary Harold L. Ickes, Administrator of the Oil Code. The statement shows that the average per-barrel cost for all states during the year 1934 was 77.5¢ and the selling price 98.4¢. These figures compare with an average cost of 71.7¢, and selling price of 67.8¢ for the year 1933. The statement further points out that the cost for 1934 rose only three-tenths of a cent per barrel compared with the last quarter of 1933 when the average was 77.2¢.

The final report covering the study from 1931 through the year 1934 is being prepared and will be available within a short time.

Manufacture and Characteristics of Carbon Steel.—H. W. Graham and J. H. Flaherty before Am. Petrol. Inst., Los Angeles, Nov. 1935.

The oil industry lives, moves and has its being with and by steel. An oil man must of necessity pick and choose among steels, and some knowledge of steel is indispensable. This paper supplies an outline of the elementary aspects of the metallurgy of carbon steel.

The manufacture of steel begins with iron making, which consists of reduction of the iron-oxide ores into metallic iron containing as impurities an appreciable percentage of metalloids. The steel making proper involves the oxidation of the metalloid impurities, the greatest possible degree of elimination of the resulting oxides, and the adjustment of the carbon content and the alloying of added elements with the steel to produce in the finished product the required characteristics.

The characteristics of steel are a function of the behavior of carbon and other elements with respect to the various allotropic forms of iron under various thermal conditions. This behavior results in varied characteristics evident in the size and distribution of various phases and constituents in a microstructure. These characteristics, in turn, impart physical properties measurable in terms of strength, ductility, hardness, and similar standards.

SHIPPING

ANNOUNCEMENT that the Bahrein Petroleum Company (Standard of California) was starting construction of a refinery on Bahrein Island has aroused the interest of British shipbuilders. Tankers will be required to carry refined products from California Standard's new source of supply in the Persian Gulf, and British shipbuilding men are speculating on the likelihood that some of the construction orders, if forthcoming, will be placed in the United Kingdom.

The company's existing fleet comprises seventeen steamers and seven motor vessels, among the latter being some Diesel electric vessels. Existing facilities are sufficient for present marketing operations, but since consumption in the United States is likely to be increased next summer when the refinery is in operation, it would appear reasonably certain that new vessels will have to be built to carry this oil. Furthermore, since Standard of California has not in the past figured in world markets, it is likely that a gesture of an international nature may be made by the placing of contracts on a fairly wide European basis. The capacity of the Bahrein refinery is stated to be about 10,000 barrels per day. This may be doubled shortly after its completion. It should be stated that no announcement has been made on the matter of new tonnage, but again, a shrewd guess may be made that new tankers will be British flag vessels, particularly as they are likely to carry fuel oil for the British navy.

Mention of navy tankers calls to mind the fact that the recent situation in the Mediterranean has necessitated the recommission of a number of such ships held for navy purposes which have been laid up since the war years. The hulls are probably in a good state of preservation because the ships have not been carrying cargoes, but the speed is a matter which must be causing grave concern to British naval authorities, since the ships are totally unsuited to keep station with any modern fleet of warships at sea. As a matter of fact, an examination of the world's navies shows that with the possible exception of Japan, no country possesses tankers capable of regular rating for naval service. Japan has attained her prominence in fast tanker ownership merely by taking full advantage of the potential power output of the modern double-acting 2-cycle internal combustion engine. This, coupled with careful thought on hull design makes possible loaded speeds of 15½ to 16 knots (virtually the average speed of a large number of mail boats today) for a very modest expenditure of fuel. Shipbuilders in Great Britain are watching the Admiralty with a view to possible inclusion of fast tankers in new programs. In view of the general unpopularity of the Diesel engine in the British navy, it is unlikely that any machinery other than steam will be considered, assuming that new construction is undertaken. Further activity can be reported on behalf of the Associated Companies of the Royal Dutch Shell group, yet even this activity should not be considered as spelling disaster to the tramp tanker owners, for it still comes within the category of replacements long overdue.

At the beginning of this year, the fleet of the Eagle Oil and Shipping Co. Ltd. comprised 31 steamers, the majority of which were old, some dating from pre-war days. Many of these have been replaced by modern motor vessels while quite recently an additional two ships were ordered on the Clyde. These will be very similar to the Anglo-Saxon 12,100 ton standard ships and will have a speed of about 12 knots. Four-cycle, single-acting, airless-injection Diesel machinery with continuous under-piston supercharge is to be employed. Coincident with the orders for the two new Eagle Oil & Shipping Co.'s vessels was a contract for two 12,000 ton tankers for the Anglo-Saxon Co. All these four ships were placed with the one yard and it is stated that this was the largest mercantile order placed on the Clyde this year. More of these replaced contracts are expected shortly. It is a general fact that while the liner tankers are of about 12,000 tons d.w., tramp tankers are larger. Confirmation of this fact is given in the latest order secured by Gotaverken, Gothenburg for a 15,000 ton tanker. This comes under the provisions of the new Norwegian law stipulating that no tanker mortgaged for more than 50 percent of the cost may be registered in Norway. This particular ship, it is stated, will cost about 3,000,000 kroner. In addition to this order, Norwegian interests, who own the majority of shares in a Swedish tanker company with one vessel running on a 10 year time charter, have placed a contract with the same company for a vessel of 12,500 tons d.w. at a price of 2,600,000 kroner.

The application of the tanker principle of carrying liquids in bulk has not hitherto found a great deal of use outside the requirements of the normal oil trade. It is interesting, therefore, to be able to record the placing in Norway of a contract for a 400 ton displacement ship, a tanker especially for the Lighthouse Office to carry oil for lighthouses. The ship will be propelled by Diesel engines and is due for delivery next winter. There are several inquiries on foot about large tankers for special duties: Among the most important of these which has recently come to fruition is a further order for an Arcform ship by the Standard-Vacuum interests.

A. C. HARDY

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MEXICO

HIGHER American tariffs and belligerent attitudes of many European countries have made the Old World the best customer for Mexican petroleum and by-products. Ministry of national economy reports that of the 16,893,688 bbl. of oil and by-products Mexico exported during the first nine months of this year, 9,589,872 bbl. went to Europe, Great Britain taking 6,670,350 bbl., Germany 1,829,-126 bbl., Holland 442,646 bbl., and Italy, Spain, Portugal, Sweden, Belgium, Ireland, Norway and Finland the rest.

Delivery of tools and machinery for drilling in the Los Soldados, Las Choapas and Aguadulce zones, southern Vera Cruz state, has been taken by Compañia Petrolera La Laguna, S.A., which is backed by Japanese interests though directed by Mexicans. The company proposes to do considerable drilling this winter.

Compañia de Petroleos de Mexico, S.A. (Petromex, S.A.) announces that it will include a cracking plant at the 2,000 bbl. daily capacity refinery it is arranging to build in the Mexico City sector to supply that market and those of neighboring towns with high grade gasoline and kindred oil by-products. Petromex has speeded up work on enlarging and improving its Tampico refinery, which is also to have a cracking plant. Petromex reportedly will start drilling soon in lands it obtained in national oil reserves in the Poza Rica zone, Vera Cruz, from the federal government as part of the administration's contribution to its "A" stock.

Ministry of national economy has granted 22 drilling permits to companies and individuals

in the Tampico zone. Mexican Eagle Oil Co. (Royal Dutch Shell) obtained four of these permits; the others went to Southern Fuel & Refining, International Petroleum; Compañia Mexicana de Oleoductos Imperio, S.A.; Compañia Unida de Inversiones, S.A.; Hamilton & Devine; and Francisco and Luz Etinne Maza. Drilling is scheduled to start after Christmas.

Mexican Eagle Oil Co. lost a suit in the national supreme court for an injunction to restrain the authorities of Tuxpan, Vera Cruz, from expropriating part of its lands in that municipality and giving it to peasants to work, in accord with the federal idle lands law.

Mexico's oil industry has entered a new era of prosperity, but the business is being conducted in a manner that is unjust to the country, asserts a review of the situation compiled by Engineer Jose D. Baez, chief of the petroleum department of the ministry of national economy.

In a preface to the review, Gen. Rafael Sanchez Tapia, minister of national economy, says that data contained therein is absolutely accurate and of high technical value and that the work brings to light facts about the Mexican oil industry that heretofore were overlooked. This review asserts that oil companies in Mexico are in a flourishing condition; that these enterprises retrieve their investments with amazing rapidity; Mexican labor produces thrice as much oil as do American workers; but that the Mexican government and workers receive four times less from the industry in the form of taxes and wages than do the American government and American workers. The review adds that revolutionary principles of the Mexican government regarding petroleum are being faithfully fulfilled; proceeds of the special tax on gasoline are being scrupulously applied to highway construction and this has increased automobile traffic; the government desires to afford gasoline consumers the fullest facilities and to that end has lowered the special impost on this commodity, but without hampering highway works now underway; ministry of national economy has carefully regulated relations between gasoline producers, distributors and consumers.

The review estimates that crude production this year will be around 40,000,000 bbl. (it was 38,171,946 bbl. in 1934); by-products production in 1935 will be about 35,600,000 bbl., against 37,331,137 bbl. last year, as the refinery of Huasteca Petroleum Co. was closed from February to May by labor troubles; domestic consumption of oil and its products is estimated at 17,700,000 bbl. this year, as compared with 16,265,795 bbl. in 1934; home gasoline consumption this year is seen as 92,470,000 gallons (it was 82,726,500 gallons in 1934), but oil exports of only 23,500,000 bbl. are expected for this year as compared with 25,018,181 bbl. in 1934.

"We deem it pertinent to make public comparative data regarding the situation of the petroleum industry in Mexico and the United States as these data will rectify false concepts and open the way to the truth," the review remarks. "Petroleum associations have published information to the effect that the oil industry in the United States paid, in 1934 to cover various taxes, $1,036,149,575 on a production for that year of 908,065,000 bbl., which amounted to a levy of $1.14, or 4.10 pesos, a barrel. Last year, the Mexican government received from the oil industry on account of various taxes—inspection, drilling, federal lands, royalties, income, production, exportations, gasoline consumption, etc.—40,000,000 pesos on a production of 38,171,946 bbl., which amounted to but 1.05 pesos the barrel, or about one-fourth of the levies paid in the United States. In the United States last year, the average daily salary or wage per person in the oil industry was $4.48 or 16.13 pesos. In Mexico in 1934, the average daily earning in the oil industry per person was 4.68 pesos, about a quarter of the wages paid in the United States. Last year, 1,250,000 workers and employees in the American oil industry produced 908,065,000 bbl., an average of 726 bbl. per person. The Mexican oil industry last year with 16,400 workers and employees produced 38,171,946 bbl., a per capita average of 2,328 bbl. slightly more than thrice that of the United States.

"In the United States, with an investment up to Dec. 31, 1933 (we lack data covering the investment up to December, 1934), estimated at $12,000,000,000, a production of 15,690,379,000 bbl. worth $19,510,984,000 was obtained, which gave an investment unity of 1.6. In Mexico, the investment up to Dec. 31, 1933 was 960,000,000 pesos and the production up to that date was 1,699,262,008 bbl. valued at 3,146,224,929 pesos, or an investment unity of 3.3—almost triple that of the United States. We do not deem it necessary to comment upon these data as we consider that they speak eloquently for themselves."

DOUGLAS GRAHAME

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CANADA

Imports

IMPORTS of petroleum into Canada for the month of October of this year were 133,728,567 gallons, valued at $3,822,571, as compared with the September total of 127,017,748 gallons valued at $3,700,395, and the October 1934 figures of 110,637,902 gallons valued at $3,327,858. The total for the seven-month period ended October 1935 was 806,578,080 gallons valued at $23,587,921, compared with 728,088,883 gallons for the same period in 1934, valued at $21,705,289.

Gasoline imports for the month of October totalled 2,082,373 gallons valued at $164,843. The September figures were 2,377,135 gallons valued at $192,891, and the October 1934 figures were 1,606,033 gallons valued at $145,308.

Miscellaneous

A $300,000 absorption plant is to be built in the south end of the Turner Valley field by the British American Oil Co. Ltd. This work should be completed within five or six months. It will have a capacity of 60,000,000 to 75,000,000 cubic feet of gas daily.

The Blackfoot Development Co. Ltd. is the name of the company which is composed of the various exploration companies which are at present seeking to develop the projects already at hand in the search for oil and gas in southern Saskatchewan. Prominent oil geologists have recommended this section of the province for further development. It is expected that drilling will be underway by the end of the year.

Early in December, Royalite Oil Company paid its shareholders a total of $523,160. This brings the total payments during the past eleven years up to $4,209,083. This is the second dividend this year, and amounted to 75c per share. The present number of shares issued is 697,547.

Model No. 3, in the north Turner Valley, struck the limestone at 5,734 feet, and drilling has now been resumed on this well.

It is expected that the Weymarn well, Pincher Creek, Alberta, will be carried down to 5,000 feet. It is now down to 3,900 feet, but work was held up for some time.

Franco Oils expect to complete their wildcat well on the Cardston structure. W. F. Thorne of this company reported that funds would be available for a No. 2 well, if necessary. No. 1 is already down 2,700 feet and oil is anticipated within the next 2,000 feet. Another interesting wildcat well is that belonging to Oil City Royalties, Near Waterton, Alberta. It is being drilled near the first well drilled in Alberta, around thirty years ago. Transportation difficulties and lack of markets caused the project to be abandoned. The new test is being drilled from 2,285 feet.

Royalite No. 26, in the north Turner Valley field, is the greatest producer in Turner Valley. The volume of the wet gas flow at two thirds of the closed pressure is 24,200,000 cubic feet per day, and its closed pressure is 1,325 pounds.

R. C. ROWE

U. S. S. R.

Official Figures For Soviet Oil Operations

1935	Crude Production (bbl.)	Daily Average (bbl.)	Runs to Stills (bbl.)	Drilling (feet)
January	13,358,000	430,935	11,400,000	248,672
February	12,704,300	453,725	10,909,500	334,000
March	14,139,300	456,609	11,714,000	449,417
April	14,058,200	468,609	12,052,600	332,843
May	15,248,800	491,897	12,516,000	421,225
June	14,232,400	474,414	12,312,300	474,029
July	14,050,000	453,226	12,315,000	449,750
August	14,230,000	469,032	12,250,000	449,900
September	14,318,000	477,267	12,300,000	448,950
October	15,160,000	487,263	12,650,000	376,300
November	15,350,000	511,667	13,400,000	375,500
Total 11 Months 1935	156,849,000	469,608	133,754,400	4,369,486
Total 11 Months 1934	154,010,300	461,309	132,481,100	3,806,188
Total 1934	168,846,700	458,042	145,141,000	4,122,898
Quota 1935 (Revised)	212,310,000	581,672	171,500,000	5,214,000
Quota 1934	214,900,000	588,876	161,000,000	4,950,000

Crude conversion: seven barrels=one ton

FOR THE second consecutive month statistics of the Soviet oil industry show an increase in production and an improvement in operation, Baku again taking the lead. Recently completed flowing wells, as well as pumping wells, have brought the total crude produced at Baku almost to plan fulfillment. Flowing wells were also reported opened at Turcomania, Bashkiria and elsewhere, but the importance of these fields as compared with Baku is such as to have but little influence upon the total crude lifted at all Soviet fields.

Estimated plan fulfillment of the major Soviet oil fields during November runs as follows: Baku, 96–98 percent; Grozni, 86–90 percent; Maikop, 80–90 percent; Bashkiria, 105–125 percent; all others, 75–80 percent (Bashkiria is the oil field recently segregated from Vostokneft and made into a separate unit).

At present, Emba oil fields are operating at the rate of about 70 percent of plan fulfillment, with showings on individual days dropping to 50–55 percent. This, however, is not unusual for Emba at this time of the year, adverse weather conditions making operations exceedingly difficult.

The Stakhanoff movement of labor productivity (somewhat similar to the Taylor system) is practically sweeping the country and it is likely that at the end of the year (1935) all Heavy Industries, with the exception of oil and coal, will show production in considerable excess of quota.

A survey of Soviet production in various branches of the Heavy Industries shows that with the exception of coal production, the oil industry has made the poorest showing in regards to percentage of the plan fulfilled during the first 10 months of 1935. The average percent ratio of the year's plan fulfilled during this period for all industries is 85.9 percent, while for the oil industry the ratio is only 79.2 percent. Reviewing last year's figures (1934) for the same period, it is found that while output of chemicals, metallurgy, power transmission and even coal, has increased 13 to 38 percent, the oil industry shows only a 3.2 percent increase in crude production and a 3.6 percent increase in runs to stills.

Soviet Industries—Percentage Fulfillment of 1935 Plan (10 Months—Jan. to Oct.)

Superphosphates	97.0
Chemicals	89.6
Rolling Mills	88.0
Copper	87.8
Machinery & Tools	87.6
Steel	86.7
Non Ferrous Metals	86.2
Cement	85.5
Metallurgy	85.1
Sulphuric Acid	85.1
Motors & Trucks	82.9
Pig Iron	82.2
Oil	79.2
Coal	78.1

In view of the tremendous efforts being made towards industrialization of the country in general and the mechanization of agriculture in particular, together with the motorization of transport, for all of which the oil industry is the most vital source of fuel supply, the present lethargic state of crude production looms as an obvious threat to the ultimate success of the plan. Throughout the country vast steppes and former deserts are being transformed into fertile fields; industrial centers and cities are springing up almost overnight, particularly in the east; the Ural region, the Volga plains and Western Siberia. Thus the Soviets are confronted with the problem not only of increasing production, but of revising the geographical distribution of sources of supply and refining centers.

In endeavoring to solve these numerous difficulties, the oil industry has had the active support of the Soviet government as well as the Communist Party and its General Secretary, J. Stalin. Thus far, however, little progress has been made. At the end of the third year of the Second Piatiletka the Soviet oil industry finds itself striving to increase production, but laboring under all sorts of difficulties. These difficulties have been specifically outlined in previous notes, but they can be summed up as lack of organization and coordination of the various branches of the industry. Plan operations for 1937 are based on a crude production of at least 336,000,000 bbl. in that year. Present indications are that 1935 production will reach about 172,000,000 bbl., which means that in order to complete successfully the Second Piatiletka, crude production must be increased at the rate of 82,000,000 bbl. per year during the remaining two years, at best a difficult task.

The Caucasian oil fields continue to be the major source of supply for the entire country, current Soviet production being derived as follows: Baku, 80 percent; Grozni, 9 percent; Maikop, 4 percent; all other fields, 7 percent. The significance of these figures is that they are symbolic of the forementioned major obstacle confronting the oil industry in Russia today; specifically, that of having 93 percent of the present source of supply concentrated in

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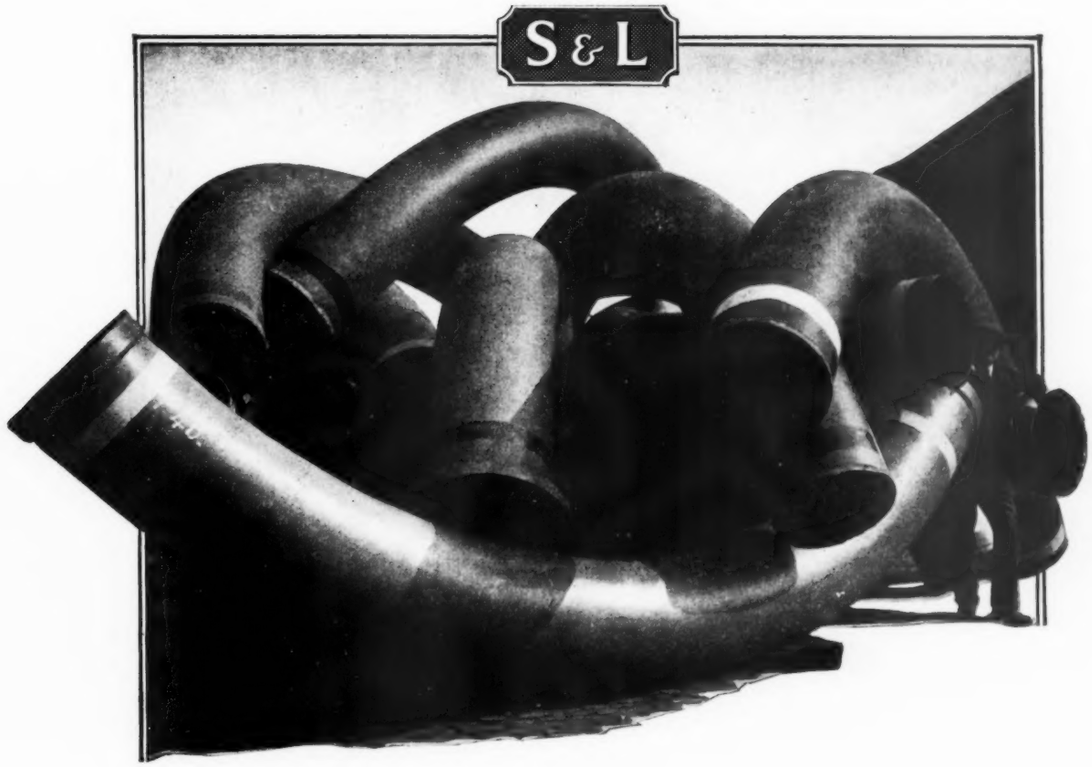

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a region inaccessible to the industrial centers where it is needed.

The Baku oil fields, which are connected by two pipelines with Batum, and the Grozni and Maikop fields, which are connected by a pipeline with Tuapse, (both Batum and Tuapse are ports on the Black Sea which have good oil terminals and facilities for export) were advantageously located when the major function of the Soviet oil industry was the export of petroleum. With the export trade relegated to a minor rôle, however, and internal consumption growing rapidly, the Caucasian fields are now decidedly disadvantageously located. Domestic distribution at present requires considerable haulage over a system of railroads, the efficiency of which is, to say the least, questionable.

The refining centers of Gorki, Yaroslavl, Saratoff, etc. which were erected to handle the anticipated crude production of Emba, Ural, Middleasia, Sakhalin and other fields (thereby facilitating the distribution of refined oil to the nearby industrial centers and easing the strain on Grozni and Baku refineries) are today practically all dependent upon crude from the Caucasian oil fields. The requirements of the Soviet cotton belt in Middleasia are estimated at about 7,000,000 bbl. of oil per year, but the Middleasia and Turcomania fields, which were expected to become the source of supply, cannot even approach this figure; the total quota for Middleasia in 1935 was only 2,000,000 bbl. The difference is obtained from Caucasian fields.

The Ishimbayevo oil field in the Urals, formerly managed by Vostokneft and recently separated from it and placed under Bashkirneft, (headed by S. Ganshin) is producing in excess of quota. Total crude lifted at Ishimbayevo during October amounted to 506,000 bbl. To refine this crude, an order for a pipe still to be erected at Ufa was placed in the United States some time ago. Another refinery of domestic design and construction will also be erected at Ufa; the total capacity of both plants to be about 7,000,000 bbl. per annum. Needless to say, Bashkirneft will prove of great help in meeting the requirements of the East, but the industrial Ural will require more oil than Ishimbayevo is producing at present. Supplying this demand without assistance from the Caucasian fields will constitute a problem for the future.

The Emba oil fields, today a minor factor

Soviet Motor Car and Tractor Production (Jan. to Oct. 1935)

		Planned Output	Actual Output
Stalin Works-Moscow (S I S)	Trucks	24,830	25,025
Yaroslavl Works	Trucks	2,090	2,107
Gorki Works (G A S)	Trucks	34,350	35,027
Stalingrad Works	Tractors	31,790	32,277
Gorki Works (GAS)	Light cars	15,125	15,819
Kharkoff Works (X T S)	Tractors & trailers	33,250	33,826
Tcheliabinsk Works (T S)	Tractors & trailers	16,580	16,489
Total light cars and trucks		76,395	77,978
Total Tractors incl. trailers		81,620	82,593

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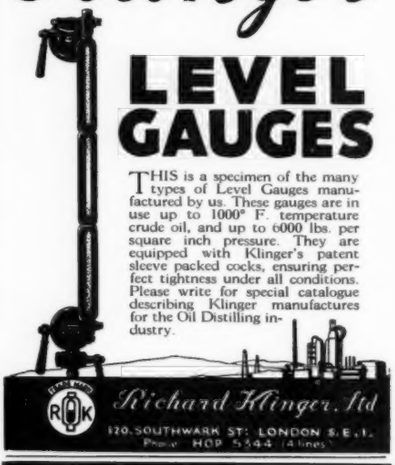

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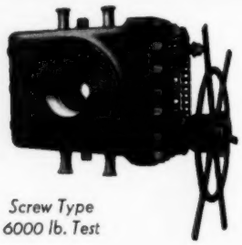

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AGENTS THROUGHOUT THE WORLD.

Soviet Petroleum Exports, Jan.-Sept. 1935
(Figures in tons)

	9 Mos. 1935	9 Mos. 1934	
Crude Oil	98,272	165,111	
Gasoline	487,485	879,492	
Kerosene	305,370	309,431	
Lubeoil	194,491	227,513	
Fuel Oil	836,795	965,709	
Diesel Oil	74,021	57,724	
Gasoil	381,107	410,465	
All Others	18,673	34,433	
Total	2,396,414	3,050,878	(−21.1%)
Value in Rbl.	29,980,000	44,090,000	(−34.2%)

Soviet Petroleum Exports by Countries

Germany	349,341	308,238
France	282,990	580,786
British Empire	213,300	340,286
Italy	170,191	480,102
Spain	151,100	389,857
Japan	112,412	17,158
Sweden	104,014	148,116
Belgium-Luxemburg	83,137	113,924
Denmark	76,013	38,124
Turkey	38,216	11,262
Iran	25,326	22,481
All Others	667,941	384,501

in the total crude supply (1,700,000–1,750,000 bbl. in 1934), are probably second only to Baku from the point of resources. Recent geological studies made at Emba have revealed that oil reserves are contained not only in the salt domes, of which over 300 are known at Emba, but also in structures situated between the domes. Further, it is probable that the oil deposits located between the domes will exceed deposits found in the domes themselves. The graviometric maximums of these deposits are reported to extend from Sterlitamak to the shores of the Caspian Sea. It is likely that between Aktiubinsk and Guryeff a territory covering 38,600 square miles is full of future oil fields. At present only Dossor, Makat, Baitchunas, Koschagil and South Iskin are under exploration, but Emba will undoubtedly disclose hundreds of fields in the future. Koschagil and South Iskin have so far yielded only flowing wells, the production of which is unsteady and can not be maintained. Of course, these wells could be put on the pump after flowing production ceases, but Emba has been neglected in the way of supplies and equipment at hand is inadequate. These two new fields have, however, doubled Emba's total crude production (original fields; Makat and Dossor).

Emba oil fields are the most natural source of supply for the rapidly growing industrial East; the crude will be carried by the Caspi-Orsk pipeline from Guryeff on the Caspian Sea to Orsk for refining and then distributed over a radius of 150 miles to the industrial centers of Khalilovsk, Mognitogorsk, Tcheliabinsk, etc., for all of which Orsk is the most strategical center. According to the estimates of the plan for the Second Piatiletka, the Soviet East in 1937 will supply exactly one-third of the total Soviet metallurgical production, about one-third of the total coal production, about one-fifth of the total production of electrical energy and one-tenth of the total production of machinery and tools.

It was anticipated that during both the First and Second Piatiletka, 55 percent of the

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total Soviet crude production would be derived from Baku fields, 32 percent from Grozni fields, and 13 percent from all other fields outside of the Caucasus. It was also expected that while production at Grozni and other fields outside of the Caucasus would increase yearly, Baku production would decline. As early as 1932 it became apparent that, actually, Baku alone would have to furnish the increased production necessary to meet the ever growing plans for industrialization, as production at Grozni and other fields fell far short of expectations.

Geological research, however, and prospecting by aerial photography, graviometry and other modern methods, have shown that Grozni still holds untapped reserves at deeper horizons, particularly in the regions of Molgabek, Vosnessenski, Benoi, etc., and that the recently discovered Podnadvig layer at old and new Grozni has possibilities of bringing about the expected comeback in Grozni production.

Outside of the Caucasus liberal oil deposits have been discovered over a vast area, from the extreme north at Petchora down through Middleasia and Turcomania in the south, and from the Volga River plains to the Urals and Western Siberia in the east. Again, as at Grozni, the geological formation of the oil bearing structures is irregular and requires deep drilling.

It is true, of course, that when the Soviets nationalized the oil industry it was practically in a state of decay. They have undertaken a complete reconstruction of the drilling, production and refining divisions and today possess a modern and progressive enterprise. Production has been more than tripled since pre-war times. Refined products, formerly limited to fuel oil and lube oil, now range from high anti-knock gasoline down to selectively treated lube oil, ash-free coke and high penetration asphalt.

Modern equipment, experienced workers, organized transportation, and settled labor with attractive wages are still needed, however, in order to put the industry on a fundamentally sound and efficient basis. Decrees issued by persons endowed with even the highest prerogative can not be miraculously effected. Whether or not the Soviets can obtain from the resources at hand in the Ural and Emba deserts sufficient oil to meet the ever increasing demand remains to be seen.

DR. PAUL SCHWARZ, former German Consul in New York, long a student of international trade in oil and who has been familiar with the Russian oil situation since pre-war days, believes that Soviet oil will sooner or later regain its position in production as well as in exports. Dr. Schwarz thinks that the total Soviet oil deposits as estimated by I. Gubkin, namely 3,000,000,000 tons (30 percent of the world's total) are somewhat exaggerated, just as the estimates of the U. S. Survey placing Russian oil deposits at 1,700,000,000 (15.7 percent) are somewhat underestimated. With 36,000,000 bbl. of crude lifted in 1922/23 the Soviets almost quadrupled that figure in 1931, but since then it has become increasingly difficult for the Soviets to live up to plans.

During the first nine months of 1935 a total of 131,600,000 bbl. of crude were lifted from all Soviet fields, of which 102,200,000 bbl. were derived from Baku and 29,400,000 bbl. from all other Soviet fields. The corresponding figures for the same period of 1934 were 118,300,000 bbl. from Baku and 26,600,000 bbl. from all other fields. The increase in production outside of Baku is practically negligible.

Soviet oil fields outside of the Caucasus are situated in regions devoid of development or civilization and it may take years before this is changed, but Soviet oil is certain to regain its position.

Diminishing exports are due to lack of surpluses and for some time the Soviets will not be anxious to increase exports or distributing facilities in other countries.

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